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NEW MECHANICAL PROBLEMS IN THE BRONCHOSCOPIC EXTRACTION OF FOREIGN BODIES FROM THE LUNGS AND ŒSOPHAGUS

BY CHEVALIER JACKSON, M.D.
OF PHILADELPHIA, PA.

IN the early days of bronchoscopy and œsophagoscopy no thought was given to the matter or the mechanical problems of the disentanglement, disimpaction or version of foreign bodies. The whole art of endoscopy was thought to consist of introduction of the instruments. This was considered a formidable task. One text-book stated in effect that if the bronchoscope could not be introduced through the mouth in fifteen minutes a tracheotomy should be done for the introduction of the bronchoscope through the neck. To-day, anyone who has been taught a proper technic, and who has instruments proper for the particular patient, should insert the bronchoscope in less than a minute. In the early days referred to, when the foreign body was seen, forceps were introduced, the foreign body was seized often along with tissues, and the foreign body was ruthlessly torn out at all hazards. In 1914 the author¹ called attention to the necessity of a careful study of the mechanical problems of foreign body disentanglement and removal and illustrated the general mechanical principles he had applied to the extraction of a large variety of foreign bodies. These were added to in subsequent publications² and³. Since then there have come to the Bronchoscopic Clinic so many different varieties of foreign bodies that now, with a total experience of 891 foreign bodies in the air and food passages, I am able to present additional data that will, I venture to think, place the matter on a scientific basis. By this I mean only a basis; future developments doubtless will make present attainments appear embryonic. It will, however, always hereafter be regarded as fundamental that: (1) A foreign body usually presents a mechanical problem of disengagement, disentanglement, version, method and location of seizure, etc., which must be worked out if low mortality and close to 100 per cent. of successes is to be attained; and (2) conversely, grasping the first part of the foreign body seen and ruthlessly tearing it out is brutal and conscienceless, and will inevitably give a low percentage of successes and a high mortality ratio.

Movements of the Bronchi.—In dealing with the problems of foreign-body extraction due consideration must be given to the bronchial movements, not only because of their increasing the difficulties in certain instances, but even more because of the invaluable aid they render to the bronchoscopist who waits and watches for the advantageous phases of their movements, as herein mentioned in connection with forceps spaces. The shortening during cough is also of advantage in protruding slender bodies that are completely within small branch bronchi, too small to enter, as first pointed out by the author.²



FIG. 1.—Cartridge primer in left bronchus of a boy aged 7 years. The mucosa had swollen proximally until it presented the problem the solution of which is illustrated in Fig. 2. Plate made by Dr. Willis F. Manges.

The movements of the tracheobronchial tree, as I have observed them bronchoscopically, may be categorically enumerated as follows:

1. Expansion during inspiration.
2. Collapsing during expiration, almost all of the collapsing excursion being at the beginning of the expiratory phase.
3. Elongation during inspiration.
4. Shortening during expiration.

5. Excessive contraction in one, many or all diameters during cough. Sometimes in children this bechic contraction is sufficient to obliterate the bronchial lumen. In the trachea of children the posterior (membranous) wall is at times projected forward convexly into the tracheal lumen.

6. Excessive shortening during cough.

7. Displacive movements in various directions, but chiefly sidewise, caused by the movements of adjacent viscera, chiefly the heart and great vessels, but in some instances by the opposite lung.

It must be remembered, that, though here listed separately for clearness, two or more of the bronchial movements are often combined, as elsewhere mentioned.²

Education of the Eye and the Fingers.—Nothing will take the place of work with the eye at the tube. The gauging of depth comes only slowly by dint

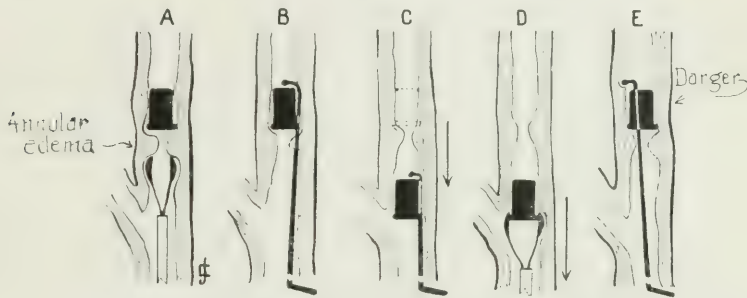


FIG. 2.—How a special probe-ended hook was used to withdraw the primer cap shown in Fig. 1 to a higher, hence wider, location in the bronchus, so forceps could be applied. Removal required 18 minutes and 33 seconds (Case No. Fdby. 841r). At A is shown the impossibility of applying forceps because of the proximal annular edema. At B the hook has been insinuated past the cap. C, the cap withdrawn above the edematous area to a widening of the bronchus where a lateral branch is given off. In this location it was easy to apply the forceps securely for the withdrawal (D). In using hooks it is necessary to be exceedingly careful to avoid pulling when the hook slips around to the wrong side (E). Pulling then might cause fatal trauma. No hook of more than a half turn (90 degrees) should be used because of the risk of getting caught in a branch-bronchial orifice. Usually they are better made spirally.

of long practice. Manipulations to be safe must be guided by the eye, and it must be a trained eye. Coördinate manipulations of the tube and forceps must be practiced until work is as natural and familiar as with knife and fork. It is as impossible as it would be brutal to attempt to acquire this coördinate skill by practice on the living human being. Appalling mortality and failure to acquire the skill would result. Fortunately the simple rubber-tube manikin³ serves the purpose perfectly, as it is always available for practice in spare moments. Next should come practice on the cadaver and on the living dog with foreign bodies of various kinds placed in the bronchi. One is never through practicing for the general education of the eye and fingers. In addition to general practice with miscellaneous objects, when a foreign body case comes in, the endoscopist should place a duplicate of the foreign body in a rubber tube of the size of the invaded bronchus, and by manipulation with bronchoscope, or œsophagoscope, as the case may be, he can familiarize himself with the appearances of the foreign body in every

possible presentation and he can study and work out a solution for every possible problem. A little ingenuity will closely simulate every difficulty to be encountered in the living patient. For instance, little useful practice will be afforded by removing peanut kernels loosely rattling round in a rubber tube of large diameter. Peanut kernels are not encountered that way in the living human bronchus; they are tightly bedded in the smallest bronchi they can enter. For simulating actual working conditions a half kernel should be pushed down into a rubber tube in which it is a tight fit. Then let the practitioner practice the removal as mentioned under "Peanut Kernels." If anyone will follow this plan he will come close to 100 per cent. successful



FIG. 3.—This coin is apparently just ready to be easily picked out with any kind of forceps. As a matter of fact a very good endoscopist, after an hour's work under ether, failed to grasp the coin for the lack of appreciation of the very simple mechanical principle illustrated in Figs. 4 and 5. Similar cases are constantly coming to the Bronchoscopic Clinic. Plate by Dr. Willis F. Manges.

removals and will have little or no mortality. I am sure that the appalling mortality that has attended bronchoscopy and œsophagoscopy in inexperienced hands would never have occurred had the operators realized how little chance there is of the survival of a little child undergoing an œsophagoscopy in inexperienced hands. This is true of simply the introduction of the œsophagoscope. How much more forcibly it should apply to complicated removals. For instance, no one should think of attempting the endoscopic removal of a safety-pin without hundreds of hours of training of the eyes and fingers to the unusual requirements of the work. To ignore this is to trifle with human life. It is infinitely worse than to attempt removal of cataracts from a living human eye without previous practice on dead animals'

eyes, which would result in blindness, not death. The removal of an open safety-pin is infinitely more difficult to learn because the cataract operation is a bimanual and binocular procedure to which all surgical work is more or less a fundamental training; whereas foreign-body endoscopy is a monocular, depth-gauging procedure surrounded by so many limitations and difficulties as to place the operator under "an indescribable stress" as Ingals so aptly stated. For a surgeon to telegraph for a bronchoscope or an œsophagoscope the like of which he never saw before and to start down the tender passages of a child in search of an open safety-pin usually ends in involuntary manslaughter, using the term literally, not in its technical sense. The author assumes part of the responsibility for these not infrequent deaths. From a mistaken sense of modesty he refrained from stating the case strongly so long as few or none had equal opportunities for experience;

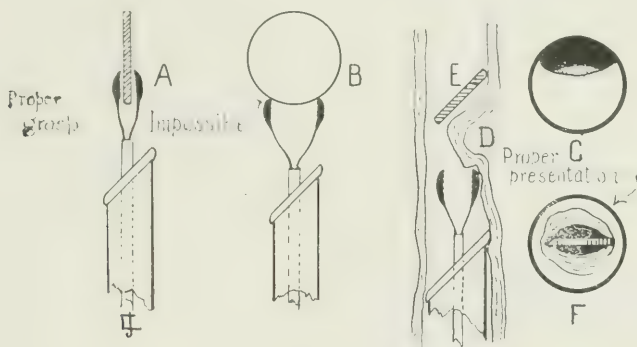


FIG. 4.—The cause of many failures to seize a coin in the œsophagus. The seizure should be flatwise as at A, not edgewise as at B. No attempt should be made to seize the coin in the position in which it is usually first seen, C, because one jaw of the forceps will strike the cricopharyngeal fold, as shown in cross-section at D, preventing the jaws from advancing far enough toward the coin to grasp it properly. The lip of the œsophagoscopic tube-mouth should be used to obtain a proper presentation as shown at F. The same principles govern the grasping of all flat objects in the œsophagus or tracheobronchial tree.

but now that every large medical centre has an experienced endoscopist, there is no more need of totally unexperienced men attempting œsophagoscopy than for every internist to do his own appendectomies.

The study of the presentation is fundamental for safety and success. In foreign-body bronchoscopy, as in accouchement, the ruthless pulling upon any part presenting without consideration of the other parts is to court disaster. Just as the obstetrician studies out the position of the fœtus and every part of its anatomy in relation to the maternal pelvis just so must the endoscopist study the position of the foreign body and the relation of its every part to the invaded bronchus or œsophagus. Just as the obstetrician depends upon abdominal palpation to aid him in his interpretation of the presentation, so the endoscopist studies the röntgenogram made in two planes, the lateral and the anteroposterior, so that he may know, when he looks at the endoscopically visible part of the foreign body, where the other parts lie. The ray-plates should be on a shadow-box in the operating room; and the

author prefers to have the plates placed upside down for a better conception of the relations in the recumbent patient. When the presentation is not a favorable and safe one for delivery, a version must be done, as, for instance, when the pointed limbs of a double-pointed tack² are turned away and the head brought into the presenting position—a cephalic version.⁴

Forceps Spaces.—Fundamental in the endoscopic removal of foreign bodies is the matter of forceps spaces, which is the name I have given to the spaces between the foreign body and the wall of the invaded bronchus or œsophagus and into which the jaws of the forceps must go before they can grasp the foreign body. Of all the causes of failure to remove a foreign body whose location has been reached, in the cases coming to the Bronchoscopic Clinic, none is so frequently the evident cause of failure as lack of

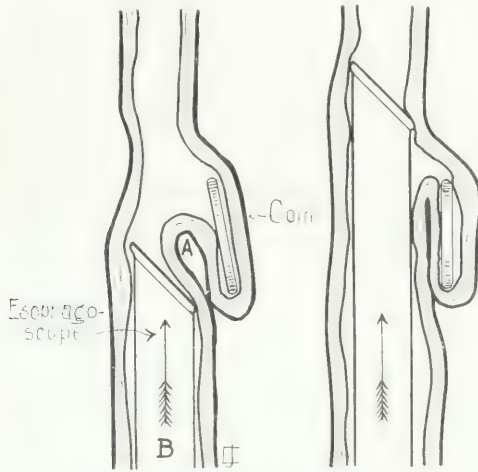


FIG. 5.—How a foreign body is so frequently overridden unseen by the inexperienced œsophagoscopist. The œsophagoscope advancing in the direction of the dart through the normally collapsed œsophagus, pushes ahead of the tube-mouth a fold, A, that obscures the view of the coin, which becomes buried in the folds alongside the advancing œsophagoscope. This is most likely to occur at the cricopharyngeus, but may occur at a number of other locations.

knowledge or appreciation of the fundamental importance of forceps spaces. Over and over again the mucosa in the neighborhood of a foreign body has evidently been traumatized in an effort to force the jaws over the foreign body when no spaces for the entrance of the jaws existed, or futilely jamming the forceps into the mucosa in an effort to force the forceps onto a foreign body with the jaws opening sagittally ignoring the lateral forceps spaces that would have facilitated grasping had the forceps been turned so the jaws would open in the coronal plane. Had the bronchoscopist been working with both eyes and both hands in an open wound, he would make no such mistake but being unfamiliar with the work and never having been taught the necessity of study of the forceps spaces, when he at last finds a foreign body for which he has been searching he thinks of nothing in his haste to use the

forceps. Many blind graspings and jabbings in the neighborhood of the foreign body not only fail to grasp it, but by the blood drawn from the mucosal vessels the intruder is so obscured that recognition afterward becomes impossible, and the foreign body is "lost." Had the bronchoscopist recognized his forceps spaces, or created one or two as the case required, the forceps could have been accurately placed under the guidance of the eye and removal accomplished in a few seconds or minutes at the first attempt. Forceps spaces are usually at their maximum on inspiration. They decrease immediately, not gradually, at the beginning of the expiratory phase of the respiratory cycle.

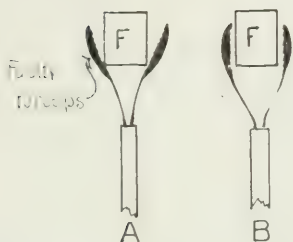


FIG. 6.—Good and bad construction of forceps. The faultily constructed forceps (A) with planes of grasping surfaces divergent, not only afford an insecure grasp, but, by reason of the small area of contact, really only pivotal, permit the foreign body (F) to swing sidewise at every touch of the natural passages, which swinging is sure to result in loosening the foreign body from the grasp of the forceps. Proper forceps (B) have the planes of the grasping surfaces parallel.

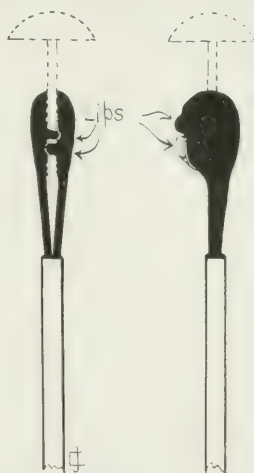


FIG. 7.—Side and top views of the Tucker forceps. The small lips added to one side of the side-curved forceps by Dr. Gabriel Tucker prevent the slipping out of the shaft of a foreign body, such as a tack or a pin, or a safety-pin, during the turning out of the point from the mucosa and the bringing of the point into the tube-mouth. This forceps adds to the Jackson method of safety-pin removal a certainty which makes this method an ideal one. The Tucker forceps are also excellent for the disimpaction and removal of tacks, pins and nails.

In some cases both spaces exist only on inspiration, and the bronchoscopist must wait and watch, with forceps jaws close to the foreign body, for his opportunity, early in the inspiratory phase of the respiratory cycle, promptly, though gently, to insert the forceps jaws into the forceps spaces as they gape. The prompt collapse of the bronchial walls at the beginning of inspiration renders it necessary to start the insertion of the forceps jaws at the beginning of the inspiratory phase. If later, the jaws will be met and stopped by the collapsing walls. Where one space only exists, and that on inspiration, one of the hereinafter mentioned means must be used to get the

foreign body into a new position in which two forceps spaces will appear either continuously or on inspiration. This respiratory opening and closing

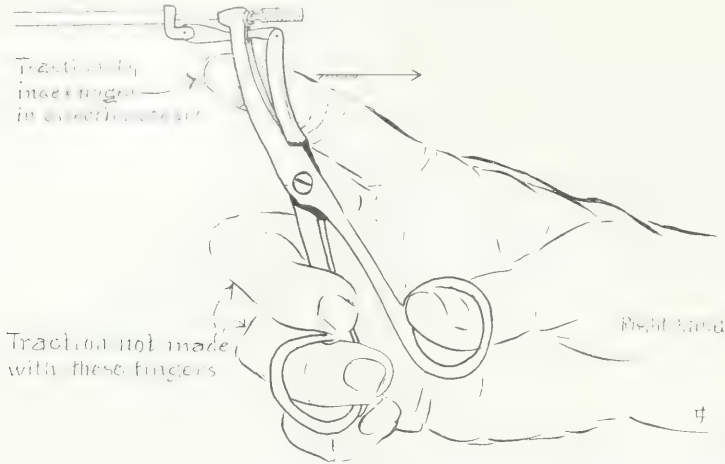


FIG. 8.—Proper manner of holding forceps. The ring-finger in the ring; the index for pulsion and traction.

of the forceps spaces is most frequently seen in cases of peanut kernels in the bronchi, in which class of cases the forceps spaces admit air (See colored



FIG. 9.—Improper use of forceps. Forceps can be so constructed as to do away with the springing upward here shown; but the delicacy of touch essential to safe and efficient work would be thus destroyed.

plate). Where forceps spaces do not exist they may be created by four different means, used singly or in combination of one or more, involving more or less change in the presentation.

1. Displacement of one wall with the lip of the bronchoscope or œsophagoscope.
2. Tilting of the foreign body with the lip of the bronchoscope.
3. Tilting of the foreign body by means of the side-curved forceps insinuated at one side and used as a hook.
4. Withdrawal of the foreign body by means of hooks of certain permissible forms, to a new position in which less swollen walls or a normally larger lumen creates forceps spaces. If withdrawal to the site of a branch bronchial orifice can be accomplished, large forceps spaces are afforded (Fig. 2).

Of all causes of failure of our predecessors to remove a coin in the œsophagus in the cases coming to the Bronchoscopic Clinic, next to failure

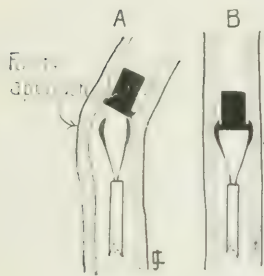


FIG. 10.—If the axis of approach is at an angle (A) instead of vertical to the presenting plane (B) of the foreign body, the intruder will be pushed down without either blade having had any chance to pass outside of the presenting part of the foreign body. The faulty angle of the approach (A) will often be encountered unless the head of the patient is moved in the proper direction to obtain an axial presentation of the bronchial lumen and an axial approach (B) to the foreign body.

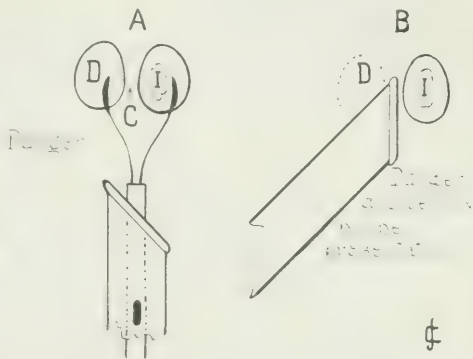


FIG. 11.—How to avoid including the dividing spur in the grasp of the forceps. If in an attempt to grasp the foreign body, 1, the forceps are allowed to expand with the bronchoscope exposing both bronchial orifices as at A, the spur is apt to be caught, giving an insecure hold, and dangerous trauma is almost certain to be inflicted. (See illustration D in the colored plate). By moving the head to the left the foreign body is presented centrally and the spur, C, is out of the way to the left, the bronchial orifice, D, passing out of the endoscopic field of vision and out of harms' way.

to find the coin because of overriding, the most frequent cause has been failure to establish two forceps spaces that would permit of proper approach and proper grasping, as shown in Fig. 10. It seems strange that a man who would naturally pick up a flat object flatwise if he were working at a bench with nippers, will try to put on the forceps edgewise in his haste to grasp a coin for which he has been, perhaps, searching a long time; yet the forceps marks on the mucosa and the statement of the unsuccessful œsophagoscopist showed clearly in dozens of these cases the faults mentioned.

Forceps.—Endoscopic foreign-body work differs from general surgery in that instruments must be properly constructed to obtain a high percentage of successes and a low mortality. The abdominal surgeon may use a kitchen spoon as a makeshift retractor without loss of time or efficiency; but the limitations inseparable from the necessity of working through a long endoscopic tube of small diameter are such that the slightest departure from the required design may make all the difference between success and failure,

indeed between life and death. For instance, the slight departure from the shape of the jaws of the forceps shown in Fig. 6 made the forceps worthless. The endoscopist who failed to hold his foreign body did not realize that though they had been foisted upon him as of my design they were faulty copies of the forceps that have stood my every test for twenty years. When properly made they convey an exquisitely delicate sense of touch. For general purposes the side-curved forceps advocated by me in the early days of bronchoscopy still remain the standby for the majority of the cases, with the plain forceps and the rotation forceps next in usefulness. On rare occasions

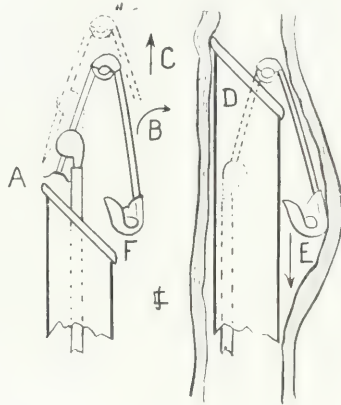


FIG. 12.—Author's method of dealing with the problem of the safety-pin lodged open and point upward. The point of the pin is always sunken into the mucosa as shown at A. The pointed branch of the pin is seized with the forceps, which are then rotated about 90 degrees, so as to get under and turn out the point as the pin is pushed downward with the forceps. This double movement is indicated by the darts B and C. The tube is then pushed downward over the pointed branch of the pin until this branch is completely within the tube (D). The pin is then withdrawn, the keeper sliding harmlessly up outside the tube (E). The keeper really lies closer than shown in the drawing which is made schematically to emphasize the fact that the keeper is outside. Care to maintain the greater plane of the keeper coronally is necessary at the cricoid in the case of the oesophagus, or sagittally at the glottis in case of the tracheobronchial tree.

it has been found advantageous to lock the forceps closed on a foreign body while at work upon it. For this a clamp is applied to the handle.

A number of special forceps for special purposes have been devised. Of my own devices there is no need of mention here. Spencer's forceps hold screws well.

My assistant, Doctor Tucker, has added a lip to the side-curved forceps which overcomes one of the greatest difficulties in turning out the point of pins, safety-pins, needles, tacks and similar objects when the point is buried in the mucosa. The lip is too short to inflict serious trauma from light grasping. Of course, if traction is made upon tissues serious or fatal trauma may be inflicted with any kind of forceps. Care and gentleness are necessary in the use of any kind of bronchoscopic or cesophagoscopic instruments.

As mentioned under "Use of Forceps," heavy construction destroys all delicacy of touch. Great strength is not necessary; but the temper of the steel must be such that it will bend before it will break. Occasionally it may

BRONCHOSCOPIC EXTRACTION OF FOREIGN BODIES

be desired in the solution of some mechanical problem to clamp the forceps onto a foreign body in a certain chosen position. For this purpose the clamp shown is used. It is so rarely required that it is made detachable and applicable to any of the forceps handles.

The use of forceps requires study and, especially, practice, so that their handling and coördination with the tubal manipulations becomes as natural



FIG. 13.—This illustration shows the advantage of turning the röntgenogram upside down for oesophagoscopy and bronchoscopy in the recumbent position. This contributes to a proper conception at bronchoscopy of where the unseen parts of a foreign body are in relation to the visible parts. The irregular, double, hook-shaped piece of metal was in the oesophagus of a girl aged three years. (Case No. Fbdy. 785). Both hook-shaped ends were buried in the oesophageal wall requiring special manipulations for the solution of disentanglement and safe removal. By comparing the schema, Fig. 14, it is seen that by placing the röntgenogram upside down all the relations correspond to those encountered at endoscopy.

and automatic as the use of knife and fork. The forceps are, mechanically speaking, a prolongation of the fingers. Their necessarily great length makes their use somewhat in the nature of walking on stilts. Special practice is necessary to acquire perfect control. This practice should be first on the rubber tube manikin and this practice should never be abandoned. It is what scales and exercises are to the musician.

The forceps should be held as in Fig. 8. This placing of the fingers can be memorized by the formula: "The ring finger in the ring." This position leaves the index finger free for pushing (always gently) on the stylet. When traction is necessary it is also made with the index finger in a mechanically correct manner, as shown in Fig. 9. It is for this use of the index finger that this forceps was designed. It gives a delicacy of touch transmitted through the most sensitive tactile member with which man is

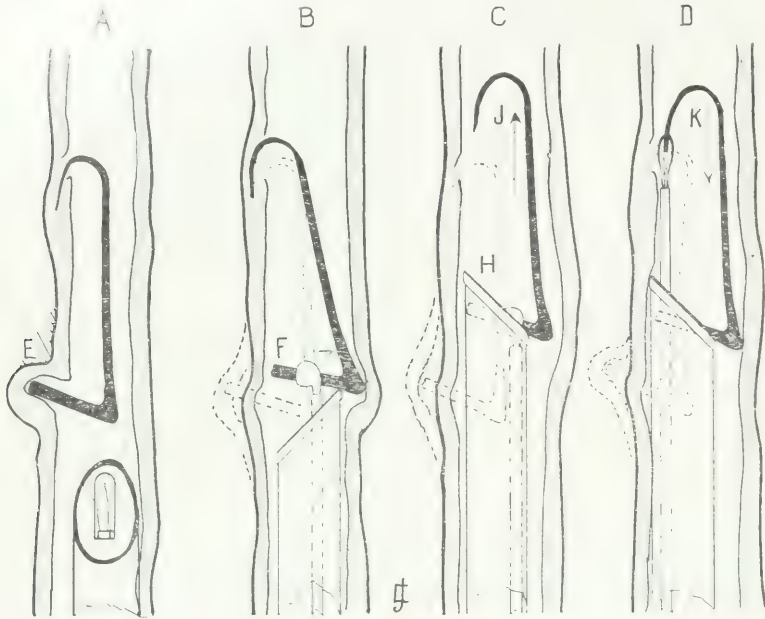


FIG. 14—Schematic illustration of the problem of the double opposed hooks presented in the case illustrated in Fig. 13. The distal hook had penetrated the mucosa, while the proximal hook, E, was buried and locked in a fold above the cricopharyngeus (E) over which it was hooked. The removal was accomplished in six stages:

- 1—Manipulation of the proximal hook strongly in the direction of the dart, F.
- 2—Guiding the proximal hook down through the cricopharyngeal narrowing, E, so as to disengage the distal hook, J.
- 3—Pushing the œsophagoscope downward so as to repress the cricopharyngeal fold, E.
- 4—Placing the lip of the tube-mouth under the proximal hook, H, to prevent its catching during withdrawal.
- 5—Seizing the point of the distal hook, K, with forceps to prevent the point catching during withdrawal.
- 6—Withdrawal of the foreign body, the forceps and œsophagoscope together as one piece.

Time required: 9 minutes and 37 seconds. No anæsthesia was used and there was no trauma and no reaction. (Case No. Fbdy. 785.)

endowed. Forceps designed to do away with the springing upward, shown in Fig. 9, are like making a violin bow of cast iron so it will not yield. The parts of a forceps outside the tube can be made as heavy as desired and opening springs may be added; but when these things are done all delicacy of touch is destroyed.

The axis of approach of forceps is of the utmost importance, and especially so in case of foreign bodies with a more or less flat face occluding most of the area of cross-section of the bronchus. As will be understood from Fig. 10, a wrong angle of approach may make all the difference between the removal in a few minutes on the one hand, and on the other, not only

failure to seize the foreign body but pushing it down tightly into a position in the bronchus from which removal may be exceedingly difficult. Before insertion of the forceps the axis of the bronchoscope should always be brought into the position in which its axis corresponds to that of the invaded bronchus. If in doing this one edge of the field of view is obscured by the projection of the angle of the bronchial wall, the obtruding angle may be repressed with the lip of the bronchoscope. Usually all that is required is the rotation of the bronchoscope so as to bring the lip around to the obtruding sector. In the œsophagus axis of approach may increase those difficulties of proper grasp due to faulty presentation and lack forceps spaces, as illustrated in Fig. 4.

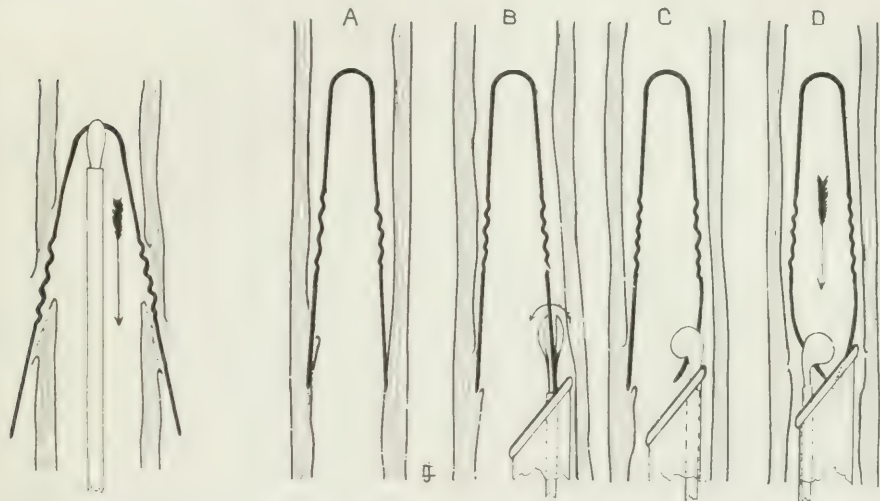


FIG. 15.—Schema showing how fatal trauma can be and has been inflicted by injudicious traction, in the direction of the dart, on a hair-pin lodged points upward in the œsophagus.

FIG. 16.—Schema showing how the danger shown in Fig. 15 was avoided by a carefully worked out solution of the mechanical problems involved. The points of an object like this have either penetrated the mucosa or penetration is imminent. First one point is turned with side-curved forceps (B, C); then the œsophagoscope (or bronchoscope) is pushed down so that the turned point rests on the lips of the tube-mouth while the other point is turned in. Thus protected, traction in the direction of the dart is safe. (Case No. Fody. 837).

Avoidance of inclusion of tissue in the grasp of the forceps is very important for three reasons: (1) Serious or fatal trauma may be inflicted by the laceration of blood-vessels. (2) Laceration of the bronchial wall may allow air and infective material to leak into the pleural cavity, producing a serious complication, or into the mediastinum, causing death. (3) Tissue between the forceps and the foreign body renders the grasp insecure. For these three reasons pulling upon a foreign body when tissue is included with the foreign body in the grasp of the forceps usually ends not only in failure to remove the intruder, but also in serious or fatal illness of the patient. See Fig. 11; also D in the color plate.

Safety-pins.—An open safety-pin, lodged point upward in the hypopharynx, is readily rotated with alligator forceps so that the point is in the

spatular tip of the laryngoscope which thus protects the tissues from laceration. The same method is ideal also in cases of laryngeally lodged safety-pins. In cases of deeper lodgment in either the cesophagus or tracheobronchial tree the pin may be similarly removed by flipping the point onto the lip of the tube-mouth or the pin may be closed or removed by the author's point-protected method² by which the pointed branch of the pin is brought as far as it will come into the tube-mouth. The pin, forceps and tube are then all brought out together, the keeper branch sliding upward harmlessly on the outside of the tube. Fig. 12 illustrates the method more clearly than the original illustration. This method will be greatly facilitated by the lips added to the side-curved forceps (Fig. 7). The chief difficulty encountered in the plan of

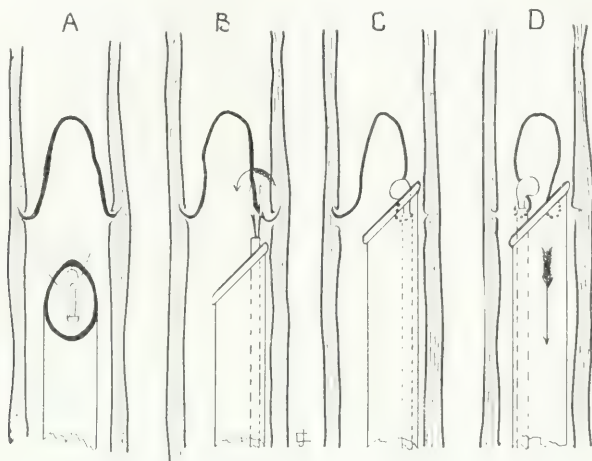
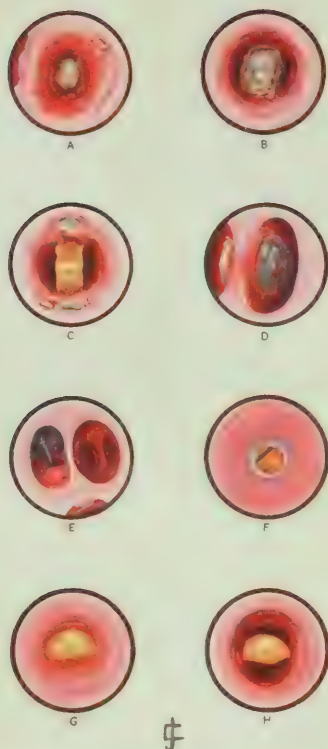


FIG. 17.—Schematic illustration of the method of disentangling a sharp-pointed, double, hook-shaped wire from an egg-beater that had lodged in the cesophagus of a woman aged 57 years, while eating custard pie. (Case No. Fbdy. 434.) The two hook-shaped sharp ends were buried in the mucosa (A). At B and C are shown the author's "outward rotation method" of disembedding buried points of any kind; in this case the wire being annealed the points were easily bent, one at a time, inward toward each other to get them into the tube-mouth for safe traction (D). The solution of the problem would be the same if the foreign body had lodged with the hooked ends downward. The method used in this early case has since been used many times in the Bronchoscopic Clinic for the removal of hair-pins, bent wire, etc.

getting the pointed branch into the tube-mouth was the tendency of the spring of the safety-pin to throw the pointed branch out of the grasp of the forceps. This the lips of Tucker's forceps prevent. These forceps make of my point-protected method the least difficult of all the plans of dealing with the open safety-pin. Closure and endogastric version are two excellent methods elsewhere described. Success and a reasonable degree of safety with any method of extraction of safety-pins lodged point-upward requires long preliminary practice on the rubber tube.

Rules for Röntgenographic Examination of Safety-pin Cases.—In dealing endoscopically with an open safety-pin, lodged point upward, the six most essential things to know beforehand are:

1. The size of the pin.



Endoscopic views illustrating mechanical problems encountered in cases of foreign bodies in the lungs. A. Foreign body (a bone) impacted in a bronchus so tightly that no forceps-spaces existed. Before admission prolonged fruitless efforts under general anæsthesia had been made to grasp the foreign body without realization of the impossibility of doing so in the absence of forceps-spaces. The inflammatory areola shows where the mucosa had been punched with the opened forceps. B. Same patient as in A after I had created lateral forceps-spaces by withdrawing the foreign body to a higher level with a hook. Forceps were then readily applied and the foreign body was easily removed. C. Mucosal trauma inflicted by the attempt to force forceps jaws onto a foreign body sagittally where no forceps-spaces existed, ignoring good lateral forceps-spaces. D. The trauma, indicated by the inflammation, the swollen dividing-spur and the patch of exudate on the mucosa of the left-hand orifice, was inflicted before admission by the faulty attempt to grasp the foreign body seen in the right hand orifice. The inclusion of the dividing-spur is easily avoided by the method shown in the schematic illustration, Fig. 11. My predecessor in the case stated that he had grasped the foreign body and had pulled as hard as he dared. As the foreign body was free to move it is certain the traction was being made upon forceps that included tissue as well as foreign body. E. Endoscopic view in the lower-lobe bronchus showing a tack that, before admission, had been injudiciously pulled upon without first disengaging the point. Release of the point by the author's outward rotation method after pushing the tack downward resulted in a prompt and safe removal. F. Annular edematous (not fibrous) stenosis from the trauma inflicted before admission, in jamming the foreign body (a screw) down in a bronchus, in a faulty effort to grasp the screw-head in the absence of forceps-spaces. On admission only a tiny portion of the screw-head was visible and the situation of the slot or fillister indicated a slight tilting of the screw. The problem in this case was solved by withdrawing the screw to a new position above the edematous area with the closed side-curved forceps used as a hook. The same forceps were then used in the usual way to grasp and remove the foreign body. G. A peanut kernel in the bronchus of a child. During expiration, as here shown, no forceps-spaces existed because of the collapse of the bronchial walls during this phase of the respiratory cycle. H. Immediately upon the beginning of inspiration the bronchial walls recede from the peanut kernel, creating large forceps-spaces between it and the bronchial walls. In the case here illustrated the spaces are located anteriorly and posteriorly. It is early during this inspiratory stage of respiration that the forceps must be placed. The here-shown phenomenon of the opening and closing of the forceps-spaces in respiration is the mechanism by which air is trapped in the invaded lung or lobe, producing the obstructive emphysema that is diagnostic of the presence of a peanut kernel in the lung. In this case Dr. Willis F. Manges had made a diagnosis of non-opaque foreign body, probably peanut kernel, in the right bronchus, in the absence of a history.

1. The size of the pin.
2. The greatest spread from the point to the keeper.
3. The exact plane of this greatest spread.
4. The direction of the point.
5. The precise location of the point, the keeper and the spring.
6. The degree to which each of the two branches of the pin deviates from the vertical axis of the patient's thorax.

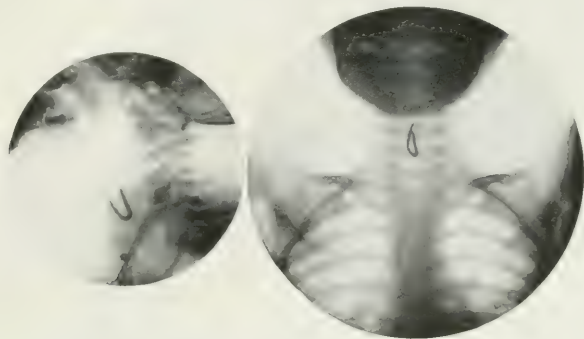


FIG. 18.—Röntgenograms, anteroposterior and lateral, showing staple in the subglottic trachea of a girl, aged 4 years (Case No. Fbdy. 825). Removed laryngoscopically through the mouth by cephalic version, in one minute and thirty-five seconds, without anaesthesia, general or local. The illustration also shows the necessity of the ray study in two planes. The lateral view conveys no idea of the complicating curves and divergent points that it was necessary to know in order to accomplish the version. Plates made by Dr. Willis F. Manges.

7. Bends, breaks, kinks or other imperfections of the pin.

More failures safely to remove safety-pins have resulted from lack of a properly preconceived mental conception of all of these data as to the particular case than from any other one cause. All of these data can be supplied



FIG. 19.—Illustrating the solution of the problem of the staple, with buried points, in the case illustrated in Fig. 18, by posterior version (C). The turning was done after working the staple upward, one point at a time (B), always guarding the advancing point. The trailing point (D) has no tendency to puncture. The laryngoscope (F) is exerting pressure (E) on the forceps in a posterior direction to complete the version.

by the röntgenologist. To get these data one plate at least should be free from foreshortening. With these data and a duplicate of the pin the trained bronchoscopist can in a few hours with his bronchoscope or œsophagoscope and a bit of rubber tubing work out the problem in such a way as to make him feel sure of safety and success in dealing later with the patient. The

working plates in the operating room should include a lateral, an antero-posterior and one free from foreshortening.

Irregular Metallic Objects.—The varieties of these are numerous; but the general principles of the solution of the problems of extraction are the same. A careful ray-study in all planes is made to ascertain the dimensions of the foreign body and the planes in which the greatest and least dimensions lie. Then a study is made to determine the position of points, rough places, hooks, angles or any other potentially traumatizing characters of the foreign body. A plan is next worked out, first in theory, then on the rubber-tube

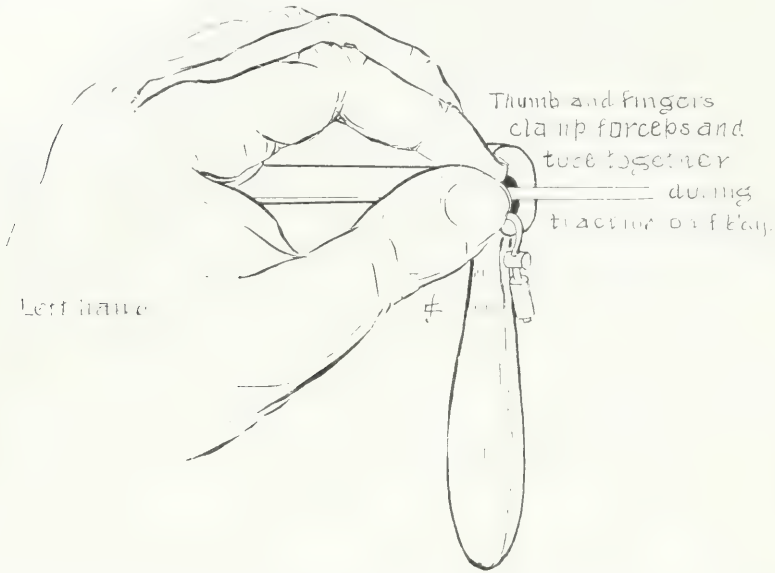


FIG. 20.—In order to avoid the lagging behind of the foreign body (see Fig. 21) and to insure the movement together of the foreign body, the forceps and the bronchoscope, all as one piece, the left hand should be used as here shown to clamp the cannula of the forceps against the proximal tube-mouth while traction is being made. The left hand should make all the traction, the right hand simply moving along passively while making the necessary degree of compression on the forceps handles. This method applies to the removal of any and all foreign bodies that are too large to be withdrawn through the tube.

manikin, by which hooks are disengaged, points guarded, rough places turned or held away during withdrawal so as to avoid trauma. A good illustration of the method of working out these various problems, or combinations of problems, is shown in Figs. 13 and 14, and will be understood from reading the legends.

Hair-pins and Bent Wires.—These cases are similar to the staple in that the points become buried (Fig. 15 and Fig. 17), but they differ in that the wire is of smaller gauge and is annealed, hence is easily bent. The fence staples are of rigid wire that cannot be bent or cut by any instrument that can be used through a bronchoscope.

The wire from an egg-beater was quickly and safely removed by the method shown in Fig. 17.

The hair-pins were removed by the method illustrated in Fig. 16. Being

of stiffer wire a forceps of different shape facilitated the bending of the points.

Fence Staples.—The surpassing difficulty in dealing endoscopically with these objects when encountered points upward, as they usually are, arises from their construction. In order to be driven into wood the points are made very sharp and the steel is very rigid. The points are spread and they rip in upon the slightest effort at traction. The wire cannot be cut or bent with any instrument slender enough to go through a bronchoscope. The method of cephalic version by which the author first solved the exceedingly difficult problem, presented by these foreign bodies when they are lodged point upward,⁴ has proven entirely satisfactory in seven subsequent cases,

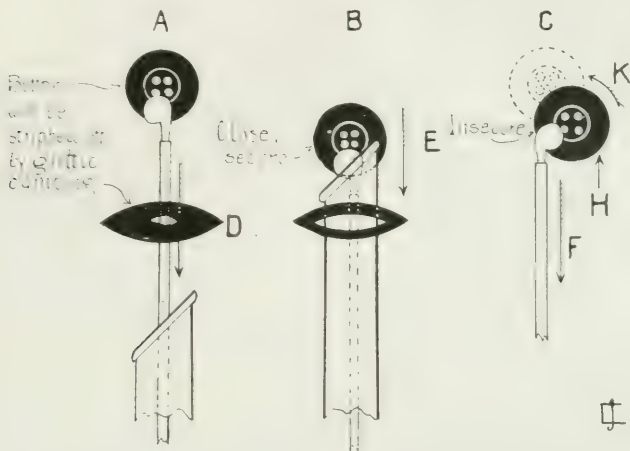


FIG. 21.—Illustrating the necessity of keeping the foreign body close to the tube-mouth during withdrawal so as to emerge with the tube (B). If allowed to trail as shown at A it will be stripped off the forceps by the glottis (D) clamping tightly around the stem of the forceps. This applies to the endoscopic removal of all foreign bodies too large to be brought out through the tube. In œsophageal work the cricopharyngeus will strip off the foreign body in the same way as the glottis does at bronchoscopy. Therefore, D, in the schema above may be taken to mean either glottic or cricopharyngeal clamping. At C is shown the fault of the one-sided grasp of any foreign body in endoscopic removal. When traction is made in the direction of the dart, F the resistance of any tissue encountered (H) by the sidewise projecting portion of the button will cause the button to be rotated in the direction K, inevitably loosening it from the grasp of the forceps. (See also Fig. 33.)

in all of which the staple was removed without mortality. The essential thing to remember in turning or otherwise manipulating these objects is that the trailing point does no harm, whereas the advancing point will rip in unless it is watched and the tissues are safely guarded. In a recent case (Fbdy. No. 825) of a staple in the trachea of a girl, aged four years, the points were found buried in the swollen subglottic tissues below the anterior and posterior commissures, respectively, the greater plane of the staple being sagittally lodged (Fig. 19). The posterior point was readily seized and advanced up out of the larynx, the anterior point being caused to trail downward as the curved head was brought upward. The head was then gently forced posteriorly against the soft-tissue wall which yielded enough to permit version. For success with staples it is essential to have beforehand

a mental conception of the staple in all its relations. For these the ray-study should be made to determine:

1. The exact length of the staple free from foreshortening.
2. The extent of the spread of the staple from point to point.
3. The plane of the greatest spread.
4. The location of the staple.
5. The degree of divergence of each of the two branches of the staple from the parallel.
6. The form, size and axis of the bronchi in the neighborhood, as shown in stereoscopic plates. If necessary, the author's method of lung-mapping by the insufflation of bismuth may be used to increase the visibility of the bronchi.

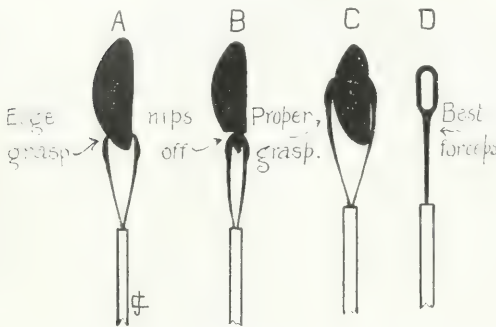


FIG. 22.—Illustrating the right and wrong ways of grasping peanut kernels and all other friable substances. If the forceps are applied close to the presenting edge (A) a fragment of the edge will be nipped off (B). With proper forceps and a gentle hand the peanut kernel will not be crushed if grasped over the minor axis, as shown at C. The author's special peanut forceps (D) have proven very satisfactory. The long soft spring of the jaws as well as the fenestra and the springless handle all contribute to gentleness of grasp with sufficient holding power.

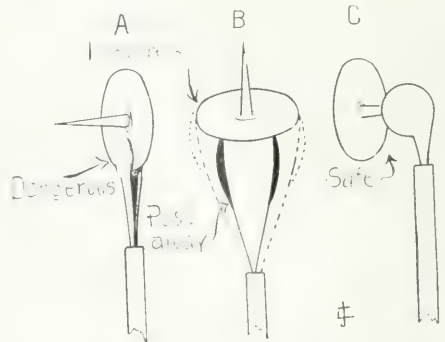


FIG. 23.—The problem of the thumb tack. If grasped as shown at A, serious and if in the œsophagus, fatal trauma will be inflicted during removal. If the flat face of the head presents, as at B, the attempt to apply the forceps will push the intruder into a lower and more difficult position; and even if the forceps were gotten over the periphery of the disk-like head as shown by the dotted lines (B) the hold would be very insecure. If the stem of the tack is grasped as at C, the hold will be secure and, most important, the point will be covered so as to protect the tissues from trauma. All other presentations should be converted into this one (C) by version with the forceps and the lip of the tube-mouth used coordinately.

Peanut kernels and similar friable substances, such as beans and maize, require great delicacy of touch. So exacting is this requirement that it is my rule when a series of cases at a clinic included a peanut case, always to take it first in order that delicacy may not be obtunded by any preceding work. Peanut kernels are especially friable, the friability varying with the degree of roasting and to a less extent with the degree of maceration. To crush a peanut kernel in the bronchus of a child is apt to cause multiple abscesses from the scattered aspiration of minute fragments that cannot afterward be found. This is a disaster to avoid which the utmost caution should be taken, while endeavoring to hold the peanut sufficiently securely to prevent its being stripped off at the glottis. For these friable substances I have used for years a fenestrated forceps; but have recently added to my equipment for this purpose an extremely delicate model of the plain grasping

forceps. The jaws are very thin, as befits the small forceps spaces usually available in these cases, and a very soft spring permits of the utmost delicacy of touch. Great strength is not necessary and these forceps are carefully kept for this particularly delicate work in which they have given the utmost satisfaction. Like all other forceps they should have a covering-clamp slipped on over the jaws to keep them closed and protected when not in use, so that the jaws will not get bent backward. All forceps should be well oiled in their cannulae before putting away. Reliability in instruments depends largely upon their care. With the very delicate forceps needed to feel a peanut kernel a well cared for instrument may make all the difference between sending the baby home well in a few days and sending him home in

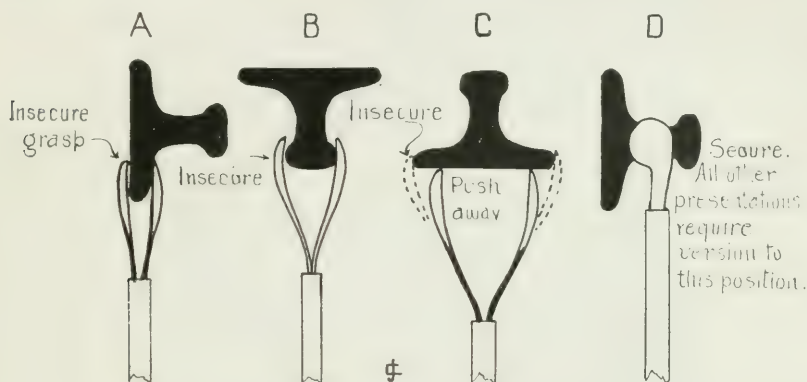


FIG. 24.—The various unfavorable presentations of the collar button and how they are converted into favorable presentations by version. At A is shown a very insecure hold; the collar button is certain to be stripped off at the glottis. At B is shown another insecure hold. In the presentation, C, it is almost impossible to grasp the collar button and the attempt is likely to push the button into a deeper and more difficult position. Even if the forceps were expanded to the position of the dotted lines the hold would be very insecure because of the tendency to tilt. At D is shown a very secure hold and in this position the collar button meets least resistance in withdrawal. All other presentations should be converted into this one by manipulation with hooks, or preferably side-curved forceps, and tube-mouth worked coordinately as knife and fork.

a box. With a delicate forceps well oiled and working smoothly in his possession the man who expects to be successful in removing peanut kernels without crushing them should crush a few quarts of peanut kernels to acquire the sense of tactile differentiation between the degree of forceps-pressure necessary securely to hold a peanut kernel during its withdrawal through the glottis and the degree of pressure that will crush it. This is a purely manual thing to be acquired only by feeling the peanuts crush and then feeling others against the tube-mouth while being withdrawn. Knowledge of how to do it is not enough. The problem is simulated for practice by inserting half of a peanut kernel in a piece of rubber tubing so small that it fits tightly. Then working through the infant size bronchoscope the forceps spaces are found, the forceps placed, and the peanut is withdrawn until it is felt to meet the distal tube-mouth. Then the forceps are clamped against the side wall of the proximal tube-mouth with the fingers (Fig. 20) so as to fix the tube, foreign body and forceps, together as one piece during with-

drawal. This method minimizes the likelihood of having the foreign body stripped off at the glottis as shown in Fig. 21. Much practice is necessary to execute this manœuvre with soft friable bodies like peanut kernels. If pulled too strongly against the tube-mouth they will be stripped off, or worse, crushed by the tube-mouth forcing the forceps shut. One great fault I find in pupil physicians at the Bronchoscopic Clinic is the nipping off of the peanut kernel by an insufficient grasp. If the forceps close on the equator of the

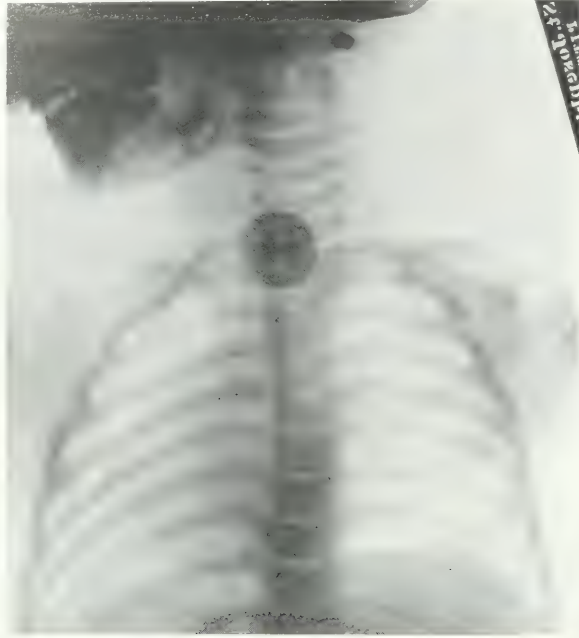


FIG. 25.—Most buttons, occurring as foreign bodies today, being made of casein, do not show. This one, of a denser composition, pearl shell, shows clearly. The mechanical problems of removal of buttons are illustrated in Figs. 21 and 26.

peanut kernel, crushing is much less likely than if the edge only is grasped (Fig. 22).

Grains of Maize usually present the germ-end the center of which is soft. If this germ is grasped it will come away leaving the "mouse gnawed" grain behind. To prevent this the grain should be grasped as shown at C, Fig. 22.

Tacks, pins, needles and similar pointed objects present problems the solution of which I described years ago.¹ These solutions have stood the test of many cases and have never failed to yield results. One great aid in the execution of these manipulations will be the new Tucker modification of the side-curved forceps (Fig. 7). The little projecting lips prevent the shaft from slipping out of the grasp of the forceps.

Collar Buttons.—The many different positions in which a collar button can present itself makes it an ideal object for practice, on the rubber tube.

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It is a typical example of the value of version in converting an unfavorable presentation into a favorable one for grasping and removal, as illustrated in Fig. 24.

Thumb tacks present a different problem from other tacks. They also present a good illustration of how a foreign body potentially dangerous may be safely and easily removed. The dangerous and the safe ways are illustrated in Fig. 23.

Very large foreign bodies in the œsophagus present difficulties that have defeated many œsophagoscopists, some of whom have gone so far as to say that external œsophagotomy with its relatively high mortality is justifiable. This I feel sure is a mistake, apart from the fact that it, in any event, could only apply to foreign bodies high in the œsophagus. Formerly I thought it

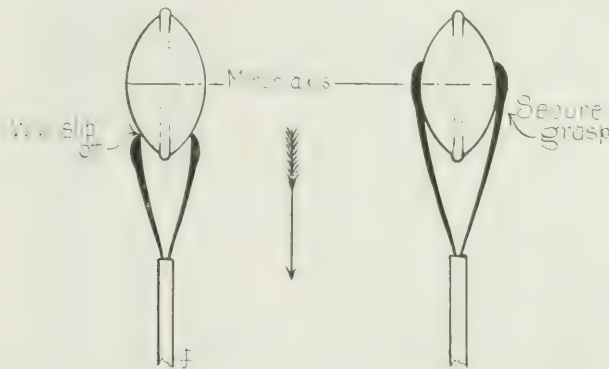


FIG. 26.—The problem of the thick, hard, smooth-surfaced foreign body of conoidal cross-section, illustrated in this instance by an ellipsoidal button. If grasped near the vertex, the forceps will slip off as soon as traction is made in the direction of the dart. To get a secure grasp, the forceps jaws must be placed beyond the minor axis of the ellipsoid, or base of the conoid, as the case may be. With spheroidal bodies, the jaw should go beyond the equator.

necessary in cases of œsophagoscopy for very large and sharp foreign bodies to relax the patient by ether anæsthesia to prevent trauma by the clamping of the foreign body by the œsophageal musculature. This I have found to be rendered quite unnecessary by the hereinafter-mentioned manipulations. Because of the development of this technic also, I have never yet had to resort to morcellation and fragmentary removal of any foreign body because of its size, though preparations for doing so have always been made. If anyone should desire to cut a foreign body it might be well to use the bouginage œsophagoscope because the increased lumen obtained by putting both the drainage and the light canals outside of the wall of the tube permits the use of large, heavy shears. Such a procedure as morcellation introduces special dangers to the patient. I have always, so far, found that any foreign body that has gone down the œsophagus could be brought back the same way, provided certain requirements are fulfilled. To have seized the large intruder with powerful forceps and dragged it out by main strength would undoubtedly have been fatal in many cases. Three precautions are necessary for safety

and success in the author's method of œsophagoscopic removal of very large foreign bodies by rotation and tubal manipulations:

1. Very careful preliminary ray-study is necessary to determine the location of any sharp corners or edges, any concavities, hooks, or other possible characters that might impede removal or cause trauma, so that such potentially traumatic factors can be eliminated by version or otherwise.

2. The largest possible œsophagoscope must be used so as to hold the œsophageal walls well spread apart during withdrawal. The œsophagoscope

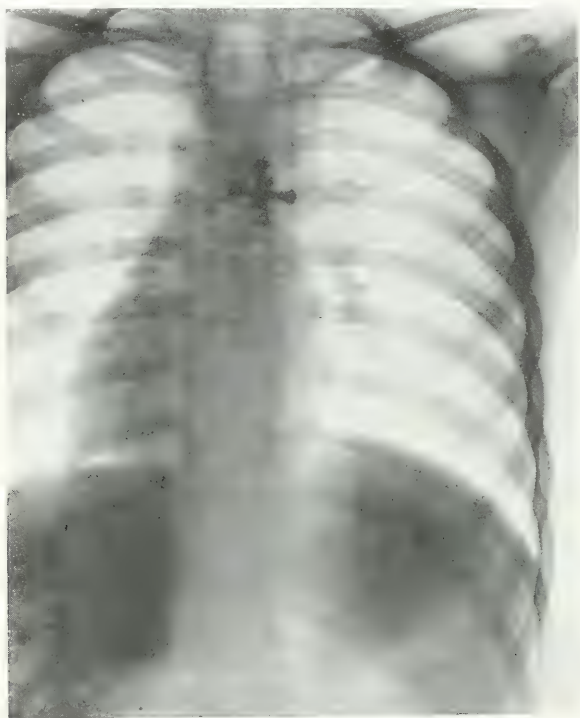


FIG. 27.—Toy jack in the œsophagus. Removal presented the problem the solution of which is illustrated in Fig. 28.

must have the regular slanted end, so as to afford the advantage of the lip in the tubal manipulation of the folds.

3. The foreign body must be brought up in the position of least resistance, doing a partial or complete version if necessary for the purpose. Rotation forceps are usually the most serviceable instruments for this purpose.

4. The foreign body must be kept close up to the tube-mouth during withdrawal for three purposes: (*a*) To keep the foreign body in the space of widely separated walls in the wake of the tube-mouth, (*b*) to keep the foreign body in view all the way up so as to enable the œsophagoscopist to carry out tubal manipulation of the collapsing folds, (*c*) to minimize the clamping of the intruder by the collapsing folds.

5. A close watch for collapsing walls and clamping folds must be maintained and these must be controlled by manipulation with the lip of the slanted tube-mouth.

These methods have enabled me to remove œsophageally lodged foreign bodies in 238 consecutive cases without resort to external œsophagotomy in any case.

Hard, Smooth Conoidal Bodies are best dealt with as shown in Figs. 25 and 26.

Toy Jacks are managed as shown in Figs. 27 and 28.

The Upper-lobe Bronchi are rarely invaded, but in their proximal portions a foreign body is readily dealt with. When their ascending branches are invaded the difficulties of work are very great, as shown in Figs. 29, 30 and

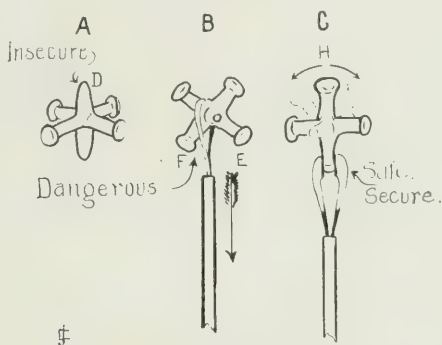


FIG. 28.—The problem of the toy jack in the œsophagus. The plain points, D, afford a very insecure grasp. The grasp with rotation forceps, B, is very secure but in this grasp the points E and F have a hook-like action similar to a graefe basket and are sure to injure the œsophageal wall by catching in a fold. The most secure grasp, and the one that should always be obtained, by version if necessary, is with a cupped forceps applied to one of the ball-points. This grasp permits wobbling (H) which permits the other points of the jack to free themselves from the fold encountered during withdrawal in direction of dart. In some cases assistance by rotation with the forceps and tube-mouth is needed to free the points.

31; but they have been to a certain extent overcome by methods being developed in collaboration with Dr. Willis F. Manges.

Magnetic Extraction of Foreign Bodies.—One of the most frequently asked questions is in regard to the usefulness of magnets in cases of foreign bodies in the lungs. There have been no developments since our report.* The limitations arise from the small size of the foreign bodies and the fact that they are not free to move. The smaller the foreign body the less the magnetic attraction. If an iron or steel foreign body were the size of a sledge hammer it could be pulled out through the chest wall. The only case in which a magnet could possibly be desirable would be that of a tiny iron or steel foreign body in a branch bronchus so small that a bronchoscope could not enter, and these are precisely the cases in which magnets are useless. Inasmuch as we have now developed methods of removing all of these, as all other kinds of foreign bodies with forceps or other instruments, it would seem that magnetic extraction is not needed. Moreover, in using a

* Jackson, Chevalier: *The Laryngoscope*, April, 1905.

magnet there is no control over the position of the foreign body in relation to the bronchi invaded or to be traversed in extraction. Hence all the niceties of disentanglement and version are impossible. However, all experiment, if not carried out on living human subjects, should be encouraged. The author hastens to add that these are only his personal views.



FIG. 29.—Röntgenogram showing a coil spring hook reaching "around-the-corner" into an ascending branch of the upper lobe bronchus of a patient. The hook went beyond the foreign body because this particular coil-spring was of too long a radius of curvature. This plate was made by Dr. Willis F. Manges, whose aid in the development of upper-lobe-bronchial work is gratefully acknowledged by the author.

CONCLUSIONS

In all cases of bronchoscopic and œsophagoscopic foreign body extraction the fundamental rule should be the avoidance of risk of mortality. Most of the operations in surgery are bimanual binocular procedures, whereas foreign-body endoscopy is a monocular, depth-gauging procedure handi-

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capped by limitations due to the smallness of the bronchi and the length and slenderness of the instruments. Differing thus from all previous training of the operator, safety and success require eyes and fingers that have been trained to the work. It is impossible, to say nothing of the inhumanity of the attempt, to get this training by work on patients. The time is insufficient. Hundreds of hours should be spent in educating the eye and the fingers with the bronchoscope working with all kinds of foreign bodies in a rubber tube, a cadaver and a living dog. Then when a case comes along a few hours preliminary working in the same way with a duplicate foreign

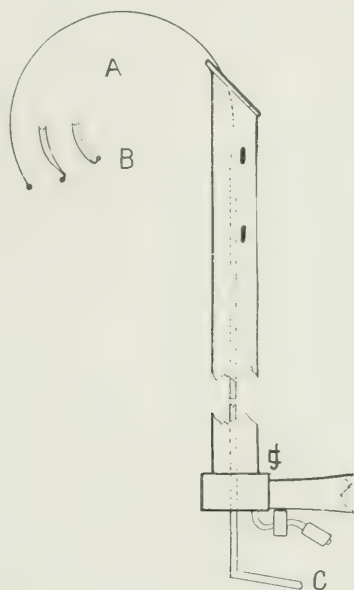


FIG. 30.—Coil-spring hooks for reaching "around-the-corner" into the ascending branches of the upper-lobe bronchus. They are straightened in their passage through the bronchoscope, resuming their curve after emergence. The degree to which this emergence is permitted regulates the distance of entrance into the upper-lobe and, to some extent, the radius of curvature; though hooks of different spring-radii are provided. The hook, proper, at the extremity (B) does not exceed a right angle in its bent position. Hooks are made in various directions, but the two illustrated (B) have the advantage that, if caught, they can be disengaged by manipulation of the handle (C).

body will provide the bronchoscopist with an experience such as he could not obtain from even hundreds of cases. If this plan of preliminary general practice followed by special practice for the particular case be conscientiously carried out, I feel sure that any foreign body that has gone down the natural passages can be brought up the same way, provided the following rules for the use of forceps or other extracting instruments are followed:

RULES FOR USE OF FORCEPS

The following rules are those formulated by the author for his own use. Hence they are stated dogmatically. The terms "must" and "should" refer only to what the author says to himself. Each operator can modify them to suit his own personal experience or equation. For convenience the

term bronchoscope is used. Almost all of the rules apply with equal force to the œsophagoscope, the œsophageal speculum and the direct laryngoscope:

1. Before insertion of forceps the long axis of the bronchoscope must be brought to correspond with that of the bronchus invaded by the foreign body.
2. The size and kind of forceps most suitable must be determined before introduction of the forceps.
3. The plane of expansion must be determined before the insertion of forceps.



FIG. 31.—Röntgenogram showing the spiral, upper-lobe bronchus forceps extending around 180 degrees in an ascending branch of the upper-lobe bronchus. Though apparently in contact with the foreign body, the forceps are in a bronchial branch about 2 cm. anterior to the foreign body. Plate made by Dr. Willis F. Manges.

4. The plane of expansion must be determined by the greatest plane of the intruder, the shape of the presenting part and the position of the forceps spaces.

5. There must be two forceps spaces, if two-jawed forceps are to be used, and they must be on opposite sides of the foreign body. If only one exists another must be made by manipulation of either the intruder or the tissues, normal or pathologic, or by working the intruder upward into a wider passage. If none exists two must be created.

6. Before applying forceps an unfavorable presentation must be converted into a favorable one by

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- (a) Creation of forceps space or spaces if only one, or none, exists.
- (b) Partial or complete version if required for disentanglement, disimpaction, disengagement of a point, or proper presentation for seizure.

7. Great care is necessary to avoid seizing tissue along with the foreign body. In the œsophagus a fold of the collapsing walls, or the cricopharyngeal fold; in the bronchi the spur between bronchial orifices, or even a duplication of the bronchial wall may be included in the grasp of the forceps. To pull, tear or twist with forceps so engaged usually means the death of the patient. If only the mucosa is nipped, fatal injury may not be inflicted, but the prolonged oozing of blood will diminish visibility by obscuring the field and by tinting the surface of the foreign body.

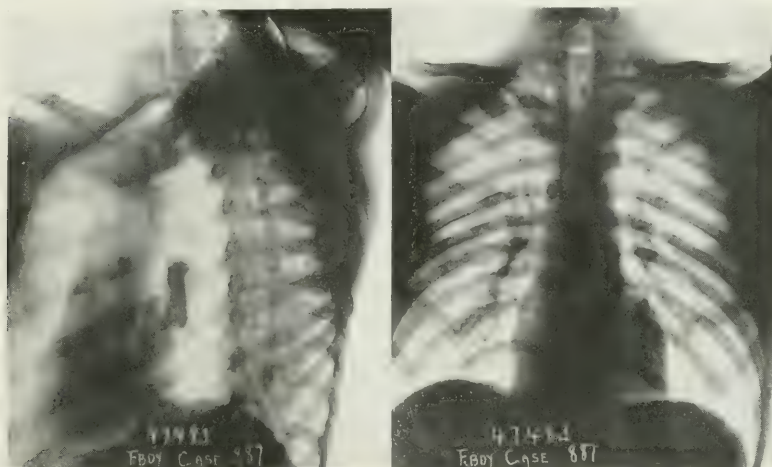


FIG. 32.—Röntgenograms anteroposterior and lateral, of a man aged 28 years (Case No. Fbody. 887). Showing a very large artificial denture in the œsophagus which before admission could not be pulled out of the œsophagus. Removed through the mouth by œsophagoscopy without anæsthesia in 2 minutes and 11 seconds by the method illustrated in Fig. 33. Plates made by Dr. Willis F. Manges.

8. Traction should never be made until it is certain that the foreign body can be withdrawn without trauma to the tissues.

9. No matter how sure you are that the foreign body is properly seized and free to be withdrawn, never pull strongly enough to tear tissues apart. The safe degree of traction can be determined by the tactile sense trained by experiment on the cadaver.

10. In many instances traction must be preceded by pulsion, or by rotation, or by both, according to the mechanical problem present, in order to free a foreign body or its point.

11. When dealing with a pointed object, no traction should be made until the point is in the tube-mouth or is otherwise protected.

12. The index finger, being keenest in sense of manipulative touch, should be used for traction and propulsion of forceps. To leave it free the middle and ring fingers are inserted in the rings of the forceps.

13. In case of foreign bodies that cannot be withdrawn through the bronchoscope or œsophagoscope, the foreign body must be held closely against the distal tube-mouth by traction on the forceps until the resistance of contact is felt. Then the cannula of the forceps is firmly fixed against the side of the lumen of the proximal tube-mouth as shown in Fig. 20. This clamps the

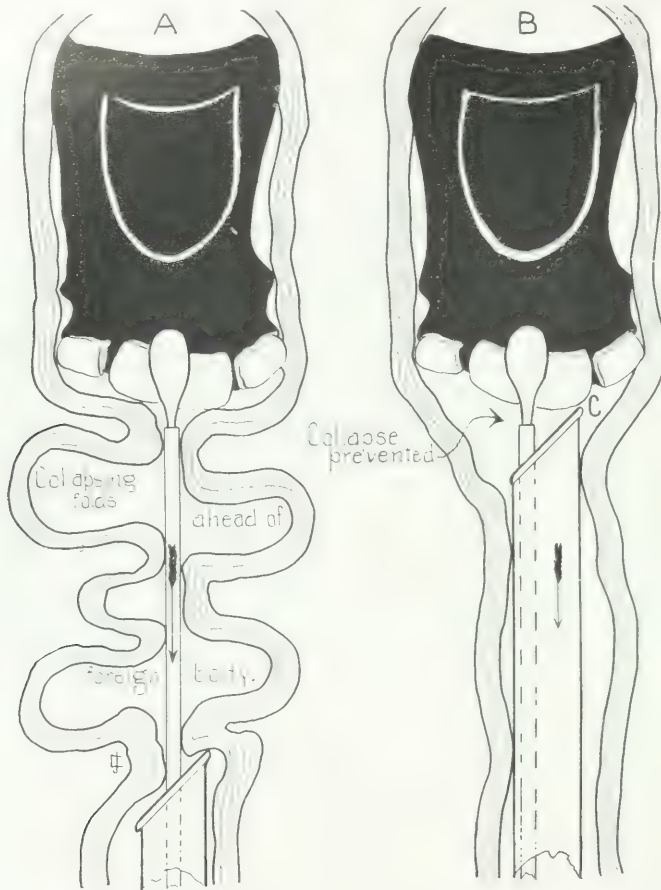


FIG. 33.—Schematic illustration of the author's method of dealing with foreign bodies of very large size in the œsophagus. In this particular case (see Fig. 32), selected for illustration, œsophagoscopy prior to admission failed because nothing short of fatal traction could bring the artificial denture through the obstructing folds (shown in illustration A), which had been allowed to collapse in around the forceps by withdrawing the œsophagoscope at a higher rate of speed than that of the forceps and foreign body. By bringing œsophagoscope, forceps and foreign body all out together as one piece, the foreign body close against the tube-mouth (B), a heavy collapse of folds is impossible. Any fold that catches the foreign body can be readily manipulated out of the way by the tip of the tube-mouth. See also Figs. 20 and 21.

three elements, foreign body, bronchoscope and forceps, together as one piece, so that all come out together. If this is not done the foreign body trailing beyond the tube-mouth, as it is almost certain to do if each instrument is held independently, will permit glottic closure on the forceps cannula before

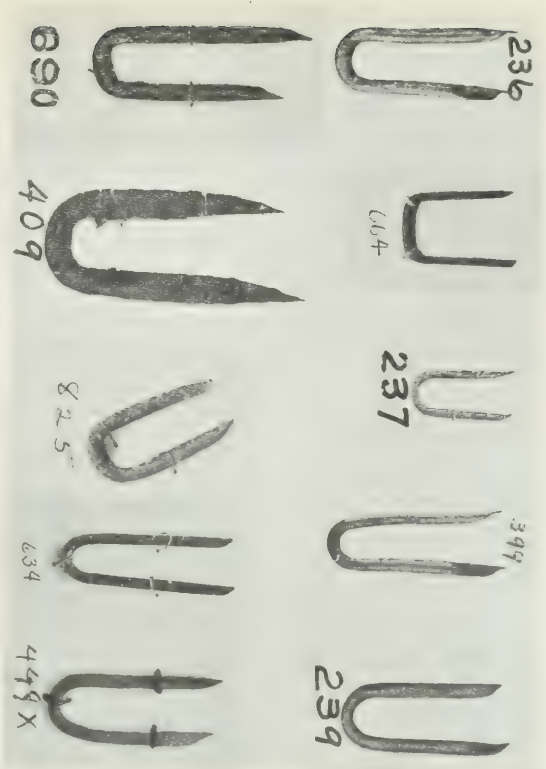


Fig. 35.—Staples endoscopically removed from the air and food passages. Foreign body No. 825 was removed by posterior laryngeal version. All the others were removed by endobronchial or endoesophageal cephalic version. That is, the sharply pointed presenting extremities were turned back so that the staple could be safely withdrawn head first.



Fig. 36. The safety-pin problem complicated by a button. The button and pin had been swallowed together; the metallic ring of the button was on the pointed branch of the pin; the entire foreign body mass being anchored by the point of the pin having perforated the esophageal wall and having hooked itself under the tightly contracted cricopharyngeus muscle. The keeper end of the pin was in the post-cricoid pharynx. The difficulties were increased by the size of the patient, an infant aged 10 days. The problem was solved and the pin was removed in one minute by the method illustrated in Fig. 12.

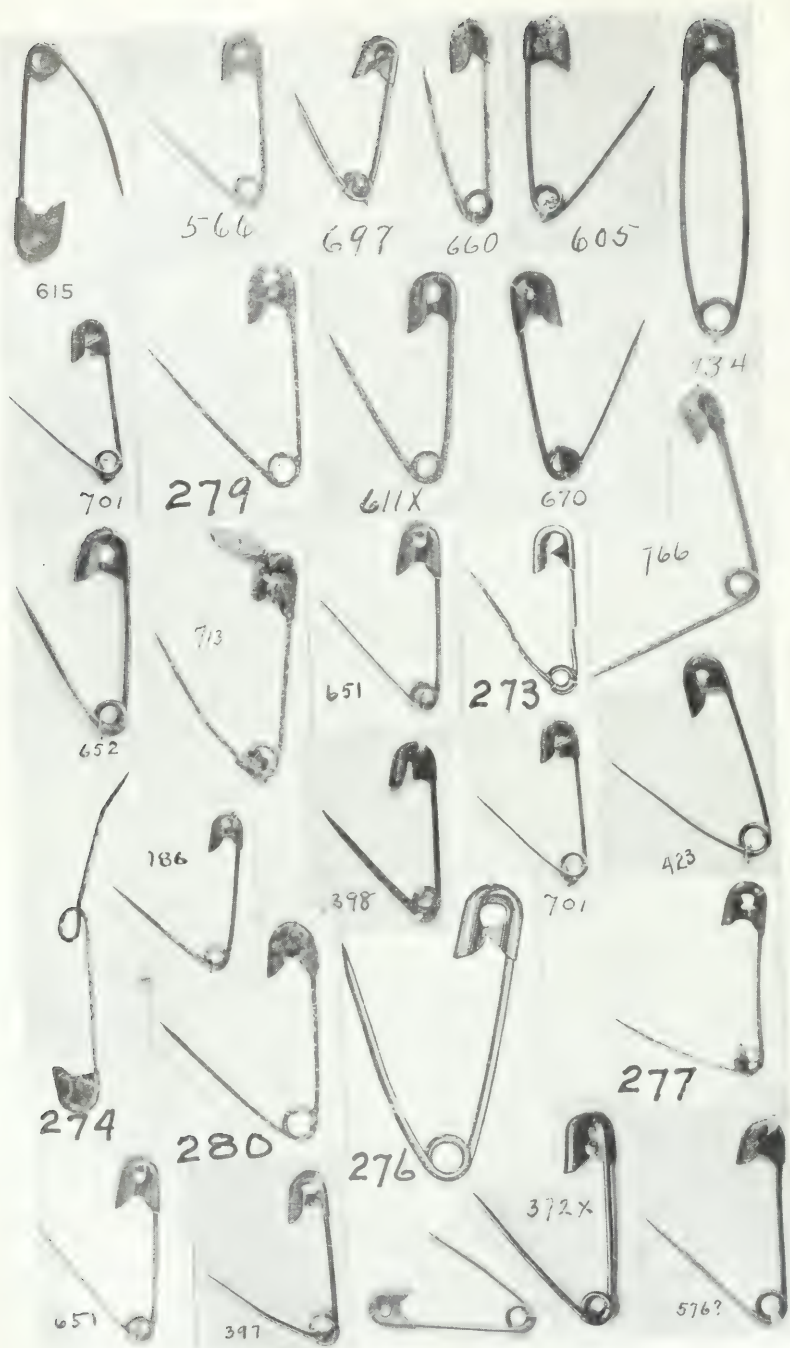


FIG. 17. Some of the safety pins removed from the air and food passages, at the Bronchoscopic Clinic by endoscopy through the mouth, without anaesthesia. Some of the open pins were closed before removal, others were removed by the point-protecting method, and still others were removed by endoesophageal or endogastric version.

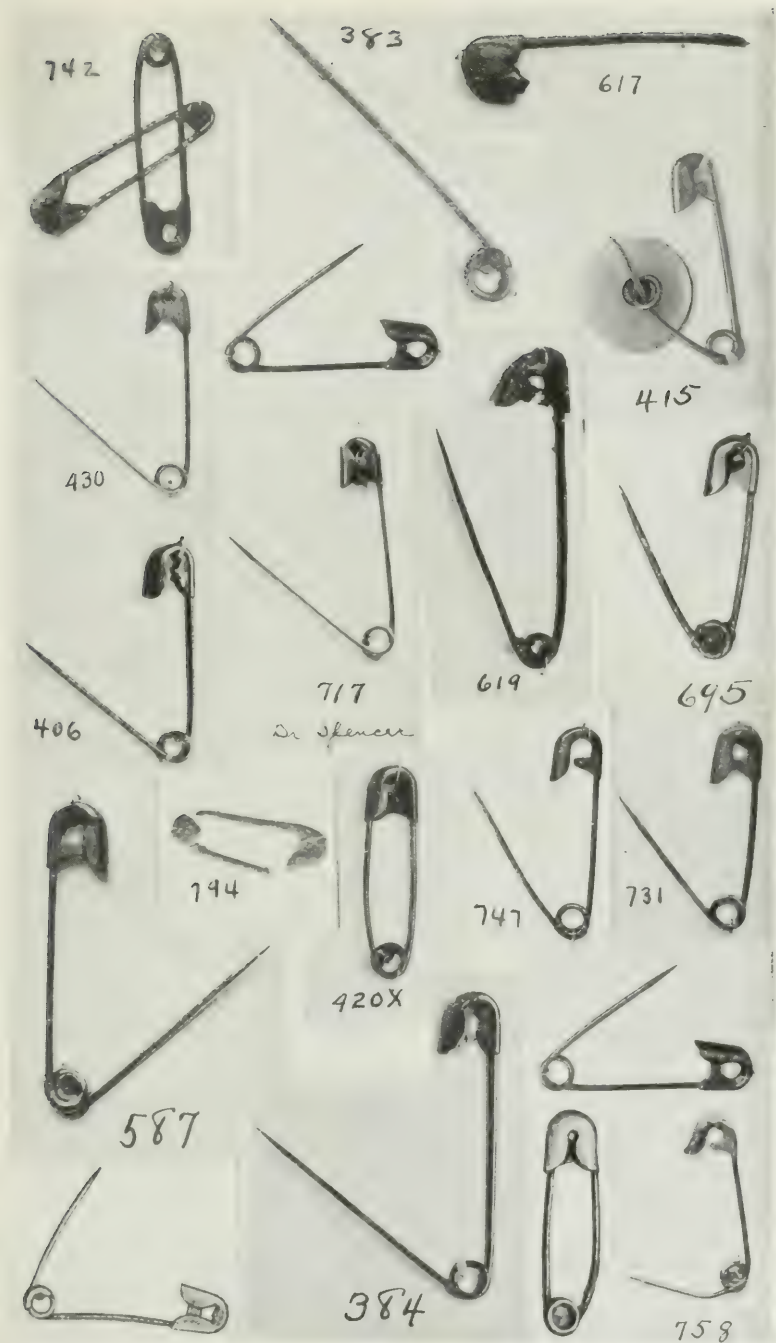


FIG. 38.—Some of the safety-pins removed from the air and food passages, at the Bronchoscopic Clinic by endoscopy through the mouth, without anæsthesia. Some of the open pins were closed before removal, others were removed by the point-protecting method, and still others were removed by endoesophageal or endogastric version.

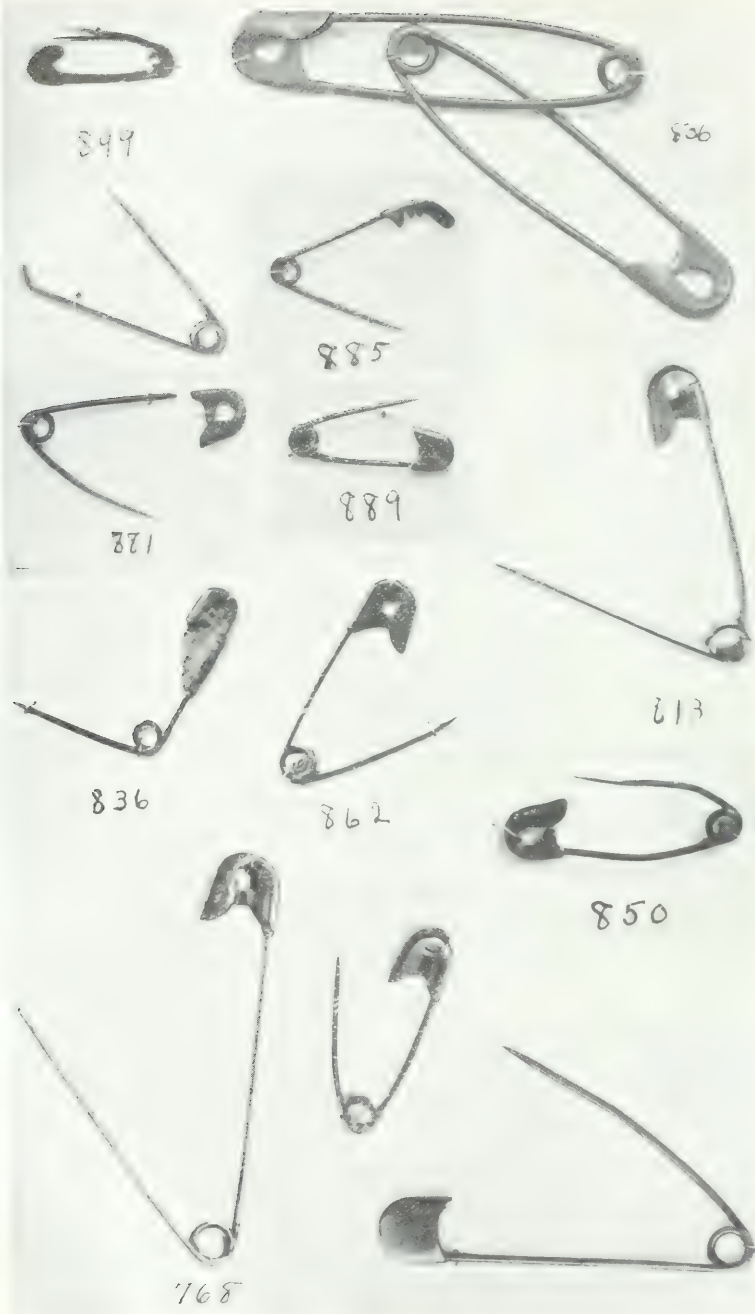


FIG. 39.—Some of the safety-pins removed from the air and food passages, at the Bronchoscopic Clinic by endoscopy through the mouth, without anæsthesia. Some of the open pins were closed before removal, others were removed by the point-protecting method, and still others were removed by endoesophageal or endogastric version.

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the foreign body reaches the glottis. The almost inevitable result is the stripping off of the foreign body (Fig. 21).

14. Before inserting forceps, the distance from the tube-mouth to the foreign body should be estimated. The jaws of the forceps going down the tube show in black silhouette against the lighted field. When the jaws reach the light they show up brightly lighted. This localization leaves only the distance from the tube-mouth to the foreign body to be estimated by depth perception.

15. Until the glint of light on the forceps is seen the jaws should never be allowed to open; and in many cases they should not be allowed to open until the intruder is reached. They should, however, open before the intruder is touched and thus displaced.

16. Peanut kernels and similar friable objects must not be grasped so firmly as to crush them. To do this and yet hold the foreign body sufficiently

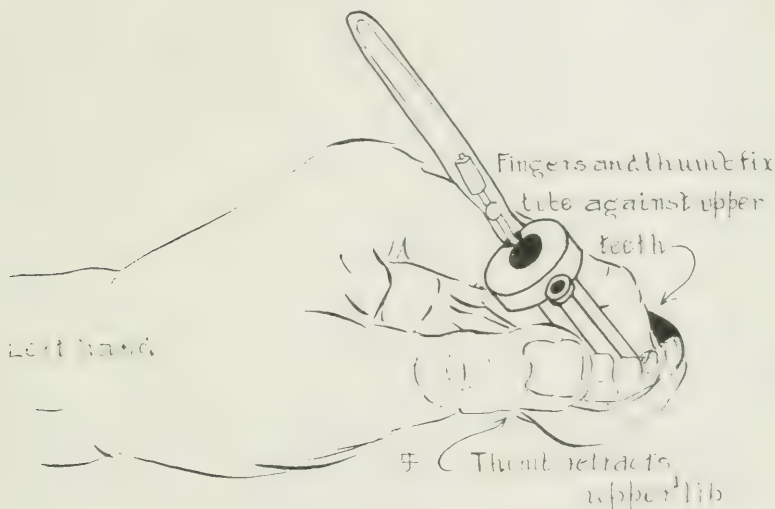


FIG. 34.—Having found the foreign body and developed the proper presentation, by version or otherwise, the tube is fixed against the upper teeth with the thumb and finger of the left hand, as here shown, in order to maintain the presentation until forceps are inserted and the foreign body is properly grasped, according to the mechanical problem presented. Neglect of this precaution is the cause of many failures.

firmly to withdraw it requires the training to be acquired only by the preliminary practice in crushing hundreds of peanut kernels with the bronchoscopic forceps. Allowance must be made for variations in resistance to crushing according to the degree of roasting and to a slight extent the degree of maceration.

17. Because of the limitations imposed by the necessity of working at a distance through a tube with one eye only, training of the eye and the fingers to the peculiar, ocularly guided, bimanual manipulations of forceps and tube are necessary to a large percentage of successes. As with all other manual things the knowledge of how to do them is not enough. Nerve-cell habit

should be established by practice until the manipulations are made subconsciously as with the knife and fork in eating.

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THE SURGICAL TREATMENT OF PERNICIOUS ANÆMIA*

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THE blood has offered many interesting, often elusive, problems to the profession, none perhaps more so than the anæmias grouped under the term "pernicious" anæmia.

In general two types of the anæmias are classified under the above; the aplastic anæmias and the hæmolytic anæmias. By aplastic anæmia is meant an anæmia in which there is decreased blood formation, aregeneratory anæmias (Barker). Vogel regards this form as a hemorrhagic or purpuric disease, that it is "primarily a leucomyelotoxicosis," and states that it can be produced experimentally by benzene poisoning.

The hæmolytic anæmias are of a number of types and are characterized by an excess of blood destruction over blood regeneration. The blood destructive agent for certain of the hæmolytic anæmias is more or less definitely known and the following groups are recognized:

1. Anæmia due to intestinal parasites (such as *Dibothriocephalus latus*, in which the hæmolytic agent is cholesteryl oleate). Mayo (*ANNALS OF SURGERY*, vol. lxxiv, 1921, p. 359) reports some observations by Logan from the Mayo Clinic upon the *Balantidium coli* as a possible cause of pernicious anæmia.

2. The hæmolytic anæmias of syphilis and of carcinoma.

3. The hæmolytic anæmias of the puerperium in which the hæmolytic agent is found in the placenta.

4. The hæmolytic anæmias due to such chemical poisons as potassium chlorate, nitrobenzene, phenyl hydrazin, the amino acids (Iwao), and oestrin (Seyderholm).

5. The hæmolytic anæmias classified as hæmolytic or acholuric jaundice which appear in both the congenital form (Chauffard-Minkowski) and the acquired form (Hayem-Widal). In both these varieties the hæmolytic agent is unknown, but it has been fairly definitely demonstrated that the pathological hæmolysis is closely related to some action on the part of the spleen.

In addition to the above there is still a large group of hæmolytic anæmias for which no definite causative agent can be said to have been found, and these may be classified as the Addison Biermer types of pernicious anæmia. It would be infinitely better to group them all under the term hæmolytic anæmias of unknown origin, to await the time when the etiological factor responsible for their existence has been recognized.

The diagnosis of "pernicious" anæmia may be made from the history of gradually progressive weakness with a marked anæmia in the absence of any

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recognizable disease of the internal organs. A definite diagnosis, however, depends upon the blood findings, viz. (Cabot) :

1. A reduction of the number of red cells, usually below 2,000,000 per cubic millimetre.
2. The high color index of the red cell.
3. A subnormal or normal white cell count.
4. The presence of abnormally large deformed or deeply staining red cells, some of which may be nucleated.

Cabot separates the aplastic anæmias from the general type and in his experience the aplastic anæmias occur chiefly in young women usually before the thirty-second year, run a rapid course and end fatally within a short period. The other type runs a more chronic course, is prone to remissions, and occurs much more commonly in men than in women.

Barker,¹ describing the Addison Biermer or hæmolytic type, considers the blood picture of this type as sometimes indistinguishable from the hæmolytic anæmias of known origin. He states that (1) it is commonest in people of middle age; (2) affects both sexes in about equal numbers; (3) the onset is insidious, the patients complaining of weakness without apparent cause, of increasing pallor (with straw-colored tint to the skin), of dyspnœa, of gastro-intestinal disturbances, and of nervous symptoms; (4) the urine is usually high colored and contains an increased amount of urobilin; (5) there is always gastric anacidity, and (6) the blood changes characteristic of a hæmolytic anæmia are demonstrable (reduced red count; anisocytosis; poikilocytosis; high color index; often regeneration signs, including nucleated red cells, polychromatic red cells and basophilic stippling; moderate leucopenia with relative lymphocytic increase, and a diminished number of platelets). There is often a little fever, but not always. He also states that the prognosis should be guarded, as sooner or later a relapse occurs which does not yield to treatment and death occurs.

In dealing with a disease in which so many factors enter as possible causes, it necessarily follows that many varieties of treatment have been tried, all with more or less efficacy in some forms. I shall have to take for granted that the various hygienic, dietetic and medicinal forms of therapy are sufficiently well known to be omitted from this paper.

The forms of treatment which are of interest to the surgeon are blood transfusions, the eradication of foci of infection, and splenectomy.

MacKenzie² points out that medical treatment has been in advance of knowledge, that treatment has been empiric, even experimental, and that knowledge has come later from the results of the attempts to palliate or cure the diseases of man. In no other field is the above more true than in the therapy of the anæmias.

Transfusion of the human blood from a selected donor whose blood is compatible has now become an established therapeutic agent, thanks to the work of Landois,³ Jansky⁴ and Moss.⁵ The methods of transfusing the blood of the selected donor are numerous, but the two forms chiefly used

are: (1) the direct transfusion of the undiluted blood by the syringe method popularized by Lindeman, and (2) the citrate method of Lewisohn.

The quantity of blood to be transfused is still a question for discussion. If the theory that the blood introduced from the donor stimulates the blood-forming organs, then small transfusions often repeated would seem the method of choice. If the new blood brought into the body by the transfusion brings some substance that inhibits or counteracts the action of some blood destructive agent, then the quantity would depend more or less upon the state and condition of the patient, and would have to be larger than the dose used to stimulate the blood-forming organs and might be said to be comparable to the use of the varying quantities of antitoxin in such diseases as diphtheria. By that I do not mean that there is any analogy between the two processes, but that larger quantities would be required for the severer cases.

If the theory that the introduced blood carried the donor along until his fatigued blood-forming organs had time to recover and to again begin to function properly, then the larger doses would seem to be indicated.

In this connection the life of the transfused blood-cell in its new surroundings may throw some light. In one of my cases of pernicious anæmia in which repeated small transfusions were done, it was possible to distinguish the introduced red cell for from fourteen to sixteen days at first. Later it began to disappear on the twelfth day, then the eighth to the ninth day, and at last could not be followed after the fourth day. The improvement in the condition of the patient and in the blood count coincided very closely to these periods, lasting three weeks at the beginning before a slump occurred and at last only four days when the case finally resulted fatally.

Mayo,⁶ quoting from an unpublished paper by Ashby from the Mayo Foundation, states that the red cells of the transfused blood in persons not suffering from idiopathic blood diseases may last from one to three months.

As yet no solution as to the quantity of blood to be transfused has been reached. It has been my experience that often repeated small or moderate transfusions have been as successful as the larger ones and are less apt to cause unpleasant reactions in either the donor or the donee.

Blood transfusion has then become an added therapeutic agent in pernicious anæmia. It is a lift, acts as a temporary stay, but has not yet cured the disease. One can readily understand why that is true when we realize that this is one of the therapeutic experiments spoken of by MacKenzie to palliate human suffering.

With the recognition of the grave systemic effect of focal infections and the part played by these infections in certain diseases and the empiric effect of the removal of these infected areas in such conditions as arthritis, foci of infections are now mercilessly eradicated in anæmic patients, based upon the theory that these infections either stimulate blood destructive agencies, or that the organisms themselves form a hæmolysin which gradually gains headway

against blood formation, or like certain poisons, benzol for example, inhibit or actually destroy the blood-forming organs.

Barker, for example, feels that the treatment of infections of the gums and teeth in patients with pernicious anæmia have been so frequently followed by rapid improvement that he agrees with William Hunter that these infections play a very important rôle in the production of pernicious anæmia.

It is not uncommon to find focal infections in individuals at forty or over, but if the organism in this infected area is not of the hæmolytic strain can it be said to be more than a coincidence?

I am heartily in accord with the view that focal infections should be eradicated in anæmias, but the organism or organisms grown from the infection should have definite hæmolytic properties before they can be considered etiological agencies. The bacteriologist will undoubtedly give us much valuable information, and the field of investigation of the action of the organisms thus obtained may give much information about some of the remittent forms of pernicious anæmia which we now see.

Percy⁷ reported twenty-four of the thirty-seven cases he had operated upon for pernicious anæmia, and reports the cultures in nine of his cases. The hæmolytic streptococcus was grown from the spleen in three cases, from other organs removed at the same time in seven out of the nine cases. He believes that, "while it is impossible to state anything definite concerning the relation of these various infections to pernicious anæmia, it is an interesting observation from the standpoint of etiology and treatment." He also believes that the rational treatment should consist of three main steps: (1) Massive step-ladder transfusions of the whole blood. (2) Splenectomy. (3) Removal of all possible sources of infection.

In none of my cases was any organism grown from the spleen, and with the exception of one case with a few suspicious teeth were there any foci of infection discoverable.

Eppinger,⁸ Descatello,⁹ and Klemperer and Hirschfield¹⁰ used splenectomy as a therapeutic measure in pernicious anæmia. Each observer was prompted to use this method because of certain observations made after splenectomy for other conditions. Eppinger noted that splenectomy was followed by a diminished output of urobilin and by other evidences of decreased hæmolysis. Descatello, by noting the improvement which followed splenectomy in hæmolytic jaundice, and Klemperer, by noting that polycythæmia sometimes followed splenectomy for rupture of the spleen, tried splenectomy for pernicious anæmia and reported marked improvement of their cases following this procedure.

My experience covers seven cases of splenectomy done for pernicious anæmia, with three improved for periods of from one to four years, and three cases in which death resulted within a year following the operation, and one too recent to state the final outcome.

In another paper, in discussing the effect of splenectomy in pernicious anæmia, I wrote: The anæmias in which there is a disturbance of blood for-

mation, if they can be definitely classified and recognized, cannot be benefited by splenectomy, inasmuch as the trouble does not lie in the spleen, but in the blood-forming organs.

In the other type, *i.e.*, those showing increased blood destruction, many factors as yet undetermined must be solved before the position of splenectomy as a therapeutic measure can be settled. At one end of this group one finds cases in young individuals, under forty, in which the blood picture is somewhat atypical, in which blood destruction occurs in crises (hæmatogenous crises) with periods of remission, and who have a definite enlargement of the spleen. In this variety splenectomy brings about a result comparable to that seen in the acholuric or hæmatogenous jaundice cases, and the enlarged spleen seemingly has some increased action in the process of blood destruction and its removal is followed by definite improvement if not by an actual cure.

Between these two extremes (the aplastic anæmias and the type comparable to the hæmatogenous jaundice group) is a middle group in which manifestations of inhibition of blood formation or increased blood destruction occur either separately, in conjunction, or in sequence. Just when an individual with an increased blood destruction may begin to show aplasia as a result of this constant blood destruction, or whether the factor producing the hæmolysis may likewise produce an inhibition of blood formation coincident with the increased destruction, or whether the inhibition of blood formation may produce an imperfect formation of the red cells which permits of this ready destruction, are problems to be solved. (The effect of splenectomy on the normal individual and in certain pathological conditions. *ANNALS OF SURGERY*, May, 1918.)

In a condition with so many factors which may influence our decision as to treatment, what clinical findings are there which would suggest that splenectomy might be of value? The following have impressed me as of importance:

Age: Individuals under forty-five, with an anæmia of the hæmolytic type, with attacks of blood destruction (hæmatogenous crises), with periods of remission between these crises.

The presence of a palpable spleen: The spleen is usually considered as not palpable in pernicious anæmia. The size of the spleens reported by Kumbhaar¹¹ for eighty-nine cases was, normal 28, slightly enlarged forty-one, considerably enlarged twenty. That is there was enlargement of the spleen in over 65 per cent. of the cases. He also states that the better postoperative results were obtained with the enlarged spleens. The spleen was palpable in three of my patients, questionably palpable in two, and not felt in two. The palpable cases were the largest and the non-palpable, while increased in size, were not large enough to be felt. In the other cases there was a difference of opinion among those who examined the patients as to whether the spleen could be felt or not. In all of my cases the spleen was larger than normal (265 to 500 gms.).

If the spleen is felt it is a very definite indication for removal, in my experience.

The blood findings: Lukis believes that the presence or absence of the vital staining cell is of prognostic value, *i.e.*, in the cases of anæmia in which vital staining red cells are absent, the prognosis is bad for any therapeutic measure, and conversely when they are present or increased in number the prognosis is better. It would seem wiser from the writer's limited experience to go even further than this, *i.e.*, when the vital staining cells are absent or present only in a little less than the normal ratio, splenectomy can be of little or no help. If the vital staining cells are present in an increased ratio above the normal, splenectomy should be considered.

If the blood findings show that the reticulated cell is present in less than normal ratio, blood transfusion should be done. If this increases the number of the reticulated cells, it is a help in deciding for splenectomy. If the cells are not increased by this means, splenectomy does not help.

After the splenectomy, if there is a marked increase in the reticulated cell, the case is more likely to benefit by the operation.

Minot¹² considers that the blood platelets give the best information as to bone-marrow activity. If they are absent or present in small numbers the bone-marrow is deficient in action. If large numbers are present the bone-marrow is active and this latter group improve most by splenectomy and transfusion. Minot, furthermore, found that the cases submitted to splenectomy benefited more and remained well longer after blood transfusion than those in which blood transfusions alone were used.

In my experience the reticulated cell has been of more help than the platelets, but my series is entirely too small to be of any great value in arriving at a decision.

Furthermore, those cases which show improvement following a transfusion and who do not return to quite the low ebb that existed before, seem to be benefited by splenectomy.

Fragility of the red cell as tested by hypotonic salt solution. Hæmolysis of the red cell by this method varies for the different types. If the red cell is less resistant than normal before splenectomy the patient will be improved by the operation, and the greatest improvement in my series occurred in the case with the most fragile red cell.

Splenectomy is contraindicated in the elderly individuals, in the cases with spinal cord symptoms, and in the aplastic cases.

In the others I believe with Percy¹³ that transfusion, the eradication of foci of infection and splenectomy are valuable adjuncts to our present therapy.

When all our fragmentary knowledge is placed together, it becomes increasingly more evident that the anæmias are as yet but little understood. Our knowledge will be augmented by the study of all the factors above enumerated, but will require the assistance of all the laboratory, technical and chemical skill at our command to decide upon the method of treatment to be used for the given case.

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If splenectomy is to be considered I would make a plea for the early arrival at that conclusion, as the early cases do much better than those in which splenectomy is done as a last resort.

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WOUND EXCISION AND EARLY RECONSTRUCTION IN THE TREATMENT OF COMPOUND FRACTURES*

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THE important relation between wound excision and early plastic surgery was constantly in evidence with those assigned to reconstruction hospital service during the world war. Many badly mangled extremities were saved, with all structures essential to function preserved, but were almost useless because of paralysis, stiffness or contracture. This was inevitable with the difficulties unavoidable in military surgery, but much better results should be expected from similar injuries in civil practice.

Observation of conditions in a number of general hospitals in surgical centres leads to the feeling that we are not profiting by the lessons of the world war in the management of these conditions as we should. Of course, this is not true of all hospitals; but could not many hospital-bed days, much dressing material and time of internes and nurses, to say nothing of valuable lives and limbs, be saved by the adoption of the standard instructions to the resident staff as to wound excision, methods of disinfection and general measures of reconstruction by the surgical services in charge of many members of this Association? Frequently we are inclined to ask, what percentage of industrial and other accidents could have been more efficiently treated by the better surgical teams of war times? Yet such team-work and surgical care is much more readily possible in almost any of our home hospitals than in military practice in time of war. War experience showed clearly that much of such surgery need not be done personally by surgeons in charge, but could be delegated to well-trained younger men fairly instructed how to carry out the work. The yearly increasing thousands of accidents resulting from modern traffic and industrial conditions makes the most efficient management of such injuries a problem of vital importance, for the numbers in loss of life as well as function equal or exceed those in any field of pathological surgery.

As urged in a paper published over twelve years ago,¹ the most important consideration in the management of compound fractures is still the wound of the soft parts. "If our wound is aseptic, tetanus and blood poisoning are impossible; bony union and a movable joint (Figs. 1 and 2) are favored; osteomyelitis will not develop; and a useful, if not perfectly normal, extremity

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FIG. 1.—Wound excision operation performed 1905. Compound comminuted fracture of patella. Kicked in the knee by a horse. Wound contaminated with horse manure. No trouble from silver wire sutures five years after operation.



FIG. 2.—Perfect flexion of knee both voluntary and passive in fracture of patella, shown in FIG. 4. Patient able to do all kinds of farm work without any disability.

will usually be saved." The importance of various measures of reconstruction is equally important. Unless we can save or restore the main nerve or blood supply the extremity must be sacrificed. The importance of preserving the function of tendons and certain joints is almost equally great. The ideal, where possible, is to carry out necessary reconstruction procedures at the time of excision.

With regard to wound excision itself the question arises, were the best methods used where possible during the war, and are they now being used? To help throw light on this question, some experiments were done in the laboratories of physiology, bacteriology and histology of Cornell University and New York State Veterinary College. I take this opportunity to acknowledge my indebtedness to Profs. Sutherland Simpson, B. F. Kingsbury and V. A. Moore and their associates, Prof. H. J. Milks and Doctors Carpenter and Hitchcock. The problems which we undertook to solve were as follows:

1. Is it possible to disinfect an extensively infected wound, especially the external wound, thus preventing contamination of the clean excised area during excision?

2. What is the relative value of various antiseptics (*a*) in killing bacteria, and (*b*) in penetrating lacerated and contused tissue?

3. Is it possible so to stain lacerated tissue as to be of material help in outlining the injured from the uninjured tissue?

First. In the attempt to solve the first question as to the disinfection of infected wounds, animals which were used in experimental physiology were first killed with an anæsthetic. Extensive lacerated and contused wounds were then made by driving a rusty bolt into the tissues with a mallet, by crushing the extremities in a vise against a rough stone, and by tearing with a large rusty hook. The rusty bolt, hook and stone used in making these wounds were all thoroughly contaminated with a culture of a very resistant spore-forming organism. To attempt to disinfect these badly lacerated, contused and definitely contaminated wounds the following antiseptics were tested: (*a*) Saturated solution of permanganate of potassium (this was used because of its oxidizing value with special reference to the anaërobic spore-formers); (*b*) pure carbolic acid solution; (*c*) strong formaldehyde solution; (*d*) Harrington's solution (1 to 500 bichloride of mercury in 90 per cent. alcohol with 2 per cent. hydrochloric acid) and dichloramine-T 5 per cent. The wounds were thoroughly swabbed with one of the above strong antiseptics. The results were as follows:

Wound No. 1. Potassium permanganate. Stone. All three tubes show heavy growths of *B. Chauveau*.

Wound No. 2. Carbolic acid. Bolt. All three tubes show growths of organism: No. 1, three colonies; No. 2, nine colonies; No. 3, twelve colonies.

Wound No. 3. Harrington's solution. Hook. Two tubes negative; one tube shows one colony.

Wound No. 4. Carbolic acid. Bone crushed. Three tubes show growths of organism: No. 1, three colonies; No. 2, eleven colonies; No. 3, sixteen colonies.

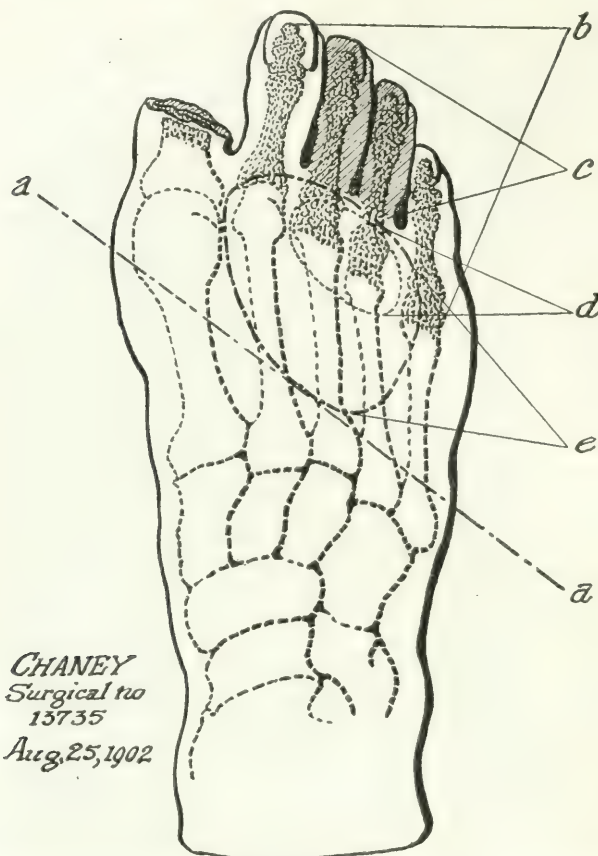


FIG. 3.—DIAGNOSIS.—Right Foot crushed with railway car wheel. Two middle toes black and gangrenous. a. Direction in which wheel passed. b. Area of crushed bone. c. Area that was gangrenous. d. Area on plantar side of foot where soft parts were entirely destroyed. e. Area on dorsal side of foot where skin was stripped off and destroyed and tendons exposed.

Wound No. 5. Formaldehyde Bolt. No. 1, negative; No. 2, one colony; No. 3, heavy growth throughout the tube.

Wound No. 6. Dichloramine-T. Bolt. No. 1, sixteen colonies; Nos. 2 and 3, heavy growth throughout the tube.

The relatively small series of tests indicated superiority of Harrington's solution and considerable value for formaldehyde solution and pure carbolic acid, but it seems that permanganate of potassium cannot be relied upon in spite of its strong oxidizing value and dichloramine-T also did not give good results.

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Second. To determine the extent of penetration of the antiseptic into lacerated and contused tissue, frozen sections of excised tissue were made and examined, which showed that, while the degree of penetration is not

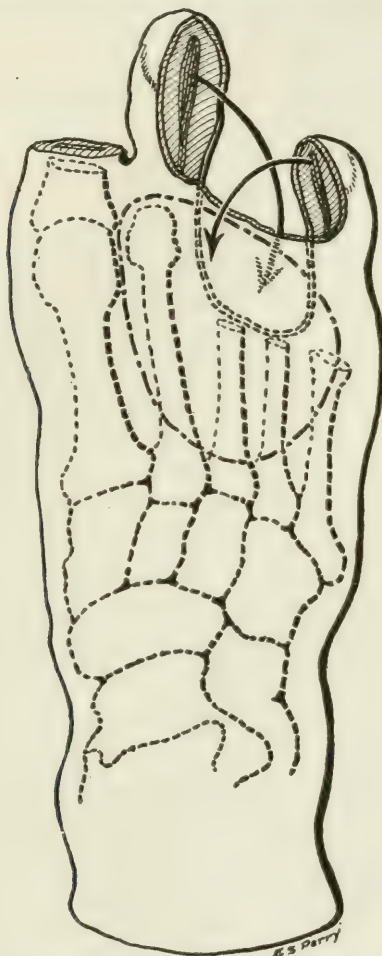


FIG. 4.—OPERATION.—Amputation of 1st and part of 2nd joint of big toe and of 3rd and 4th toes. Removal of crushed bone of 2nd and 5th toes. Soft part of 2nd and 5th toes saved for flaps.

great, it is probably sufficient to take care of practically all bacteria in case the infection has not been in contact with the tissues too long, giving the bacteria an opportunity to spread by lymphatic or blood channels.

Third. To determine the possibility of outlining the injured from the uninjured tissue the following stains were used: Strong solutions of acriflavine, methylene blue and hot saturated solution of permanganate of potassium. The distinction between stained and unstained tissue was clear enough

with any of the stains to be of great help in dissecting out the injured area, but the permanganate solution gave easily the best results. These experiments with stains merely confirmed similar ones carried out with medical officers at Ft. Riley and the results of clinical experience in civil practice in staining lacerated wounds, sinuses and fistulous tracts for excision. Anyone who has seen the difference between excision of an unstained fistulous tract and one stained to stand out from the surrounding tissues as clear as a shoestring would not be difficult to convince of the value of tissue-staining in outlining irregular penetrating wounds for excision. These methods I have used and advocated for fifteen years and am certain will prove a help to any not using them who will adopt them.

Local anæsthesia if properly used is most satisfactory in the vast majority of cases. It was used in a large percentage of the reconstruction work at General Hospital No. 26, Ft. Des Moines. Wound excision and reconstruction measures in many cases are very time-consuming, and by the use of local anæsthesia the risks are greatly reduced. Crile has demonstrated the value of local anæsthesia in combination with gas-oxygen in preventing shock; but if properly used, local anæsthesia alone gives relief from pain which is satisfactory to the patient. As is desirable in any line of surgery, so with local anæsthesia, it is necessary to get the best results to study the methods and observe the work of those accustomed to its use. Those who have attempted local anæsthesia in major surgery without such study and observation have frequently failed to get relief of pain and discarded the method without a fair trial. A minority have used local anæsthesia for many years and have proved its value beyond question in the class of cases which we are now considering. In both civil and military surgery it has the advantage of saving anæsthetic drugs and the services of a special anæsthetist for the administration of the anæsthetic. In many cases of compound fracture of the extremities it is possible to block the nerves supplying the field with relatively little anæsthetic solution. Both in this way and in certain other cases, by the massive infiltration, as used by Farr, I have succeeded in getting satisfactory anæsthesia. It is true that in certain very extensive and tedious cases the inhibition of the patient partially wears out after an hour or two, but a great deal of time under general anæsthesia can almost invariably be saved.

Skin Grafts. In the case of superficial injury, when no important structures are exposed, *immediate* or early skin-grafting saves a great deal of time in healing. The modified autogenous graft, a name which I coined ten years ago for want of a better,² requires only a small superficial denudation which rapidly heals. The use of local anæsthesia makes this a very minor procedure in most cases, and because of the relatively small amount of skin required it is generally unnecessary to go to distant parts of the body to

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get skin. The grafts resemble the "deep, small grafts" of Staige Davis, but the method of using them seems to me simpler. A line of skin is infiltrated and the skin pinched up in a roll between the thumb and finger of the operator and assistant. A long strip of skin, thin at the edges but thick in the middle, can then be cut easily with any sharp scalpel and snipped off in pieces one-

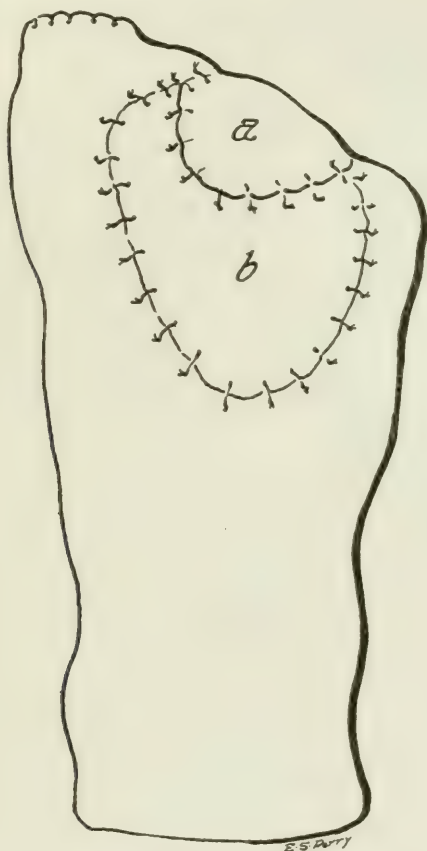


FIG. 5.—a. Soft parts of 5th toe turned over and across as flap to cover over ends of 3rd and 4th metatarsal bones. b. Skin graft from thigh over defective area.

half inch or less square. (These are supplied as islands about one-quarter inch apart to the surface it is desired to cover and usually rapidly grow together.) With free drainage and the use of mild antiseptics the grafts usually hold even in the presence of considerable infection.

Flaps. When nerve trunks, tendons and joints are exposed, skin grafts do not offer sufficient protection. A pedicled flap of skin with a little underlying subcutaneous fat gives the best results. If there has not been too great local destruction of the skin the flap may be turned from the immediate vicinity. In case of extensive destruction of soft parts of the arm, a flap

from the chest or, less desirable, the abdomen may be used. Pedicled flaps turned from the chest or upper abdomen are not used as frequently as they might be with advantage in the management of injuries with considerable loss of the soft parts of the hand or forearm. A full-thickness flap of almost any size or shape with ample subcutaneous fat can be readily obtained from the chest or abdomen without causing later disability. The flap becomes well established in about eighteen days, when it can be cut free and adjusted if necessary. As a substitute for plaster-of-Paris or other rigid dressing, the use of wide adhesive strips and small pillows under a binder to support the arm we found in military surgery much more comfortable for the patient, and the fixation all that was necessary for healing-in of the flap (Fig. 10). The slight change of position from occasional adjustment of the binder and very elastic support of this fixation made the patients so comfortable that complaints with regard to the dressing were unusual, in great contrast to plaster-of-Paris. The defect in the chest-wall can be closed with tension sutures of silkworm gut through heavy rubber tubing, or something similar, to prevent cutting of the sutures.

Tendons.—Extreme disability always follows compound fractures of the hand or forearm in case prolonged suppuration involves the tendon sheaths. If by thorough wound excision or early effective disinfection by Carrel-Dakin treatment or other antiseptics it is possible to get fairly early healing, the results of injuries involving tendons are often surprisingly good. In dealing with compound fractures of the fingers, hand or arm, an incision along the side following up the divided tendon gives better results than an incision, as so commonly placed, directly over the tendon. With incision directly down through the tendon sheath it frequently springs out and becomes adherent, and in many cases the scar tissue alone gives a high degree of disability. Better still, an incision placed transversely in the line of the normal skin-folds gives more satisfactory results than a longitudinal incision if sufficient exposure can be obtained in this way. Mattress stitches in dealing with thin tendons or muscles usually hold, while simple interrupted stitches frequently cut out. So many failures to secure union of tendons by the use of catgut sutures have come to my notice that I feel that the use of silk or some other unabsorbable material should be urged. In case a tendon has retracted far up, it is frequently possible to reach the end with a Halsted mosquito clamp inserted into the tendon sheath, grasp it and draw it down, a much more satisfactory method than division of the sheath. Splinting or other measures necessary to hold the parts in such position as to avoid tension is desirable but should not be continued long. Usually I begin some movements at the end of a week or two, at the latest three weeks. In case repair is not possible until weeks or later, the retracted upper end of the tendon is usually adherent to the sheath, making the opening of the sheath and separation of adhesions unavoidable. In such cases, bowstring

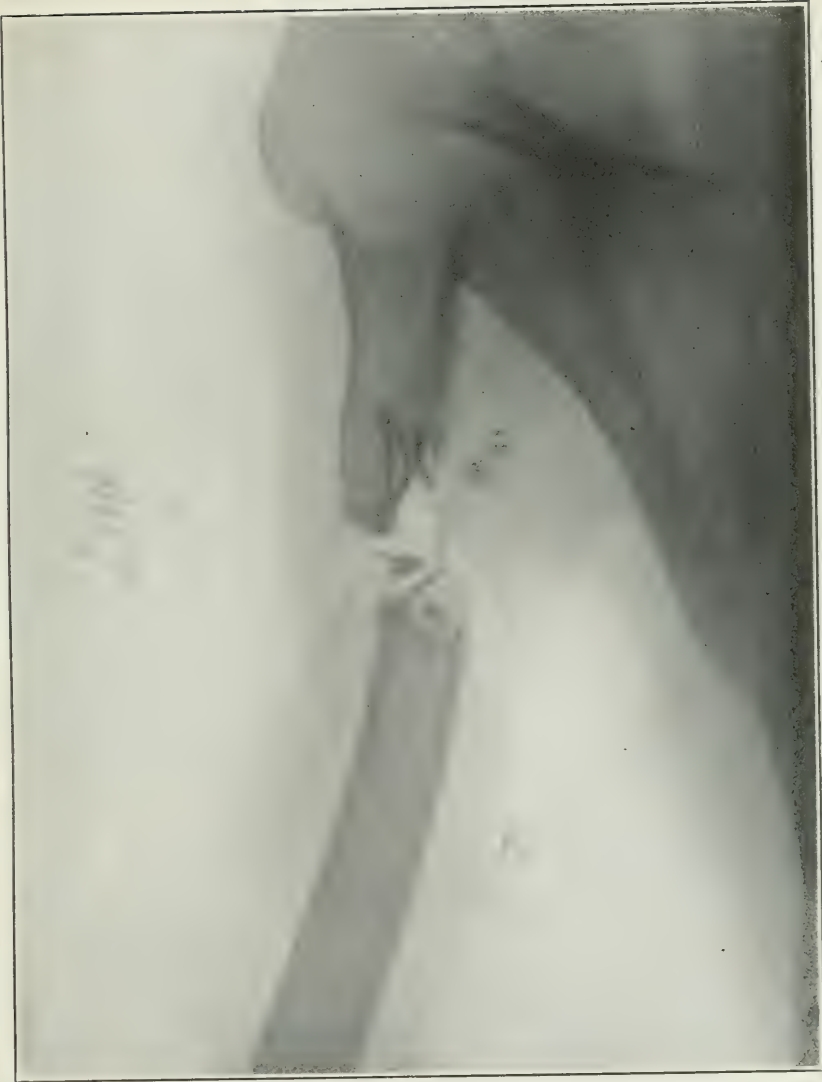


FIG. 6.—Compound comminuted fracture of humerus. Arm run over by freight car and bone crushed into minute fragments over width of car wheel. Attempt to suture with silver wire unsuccessful, but wire caused no trouble. Bone grafting refused.

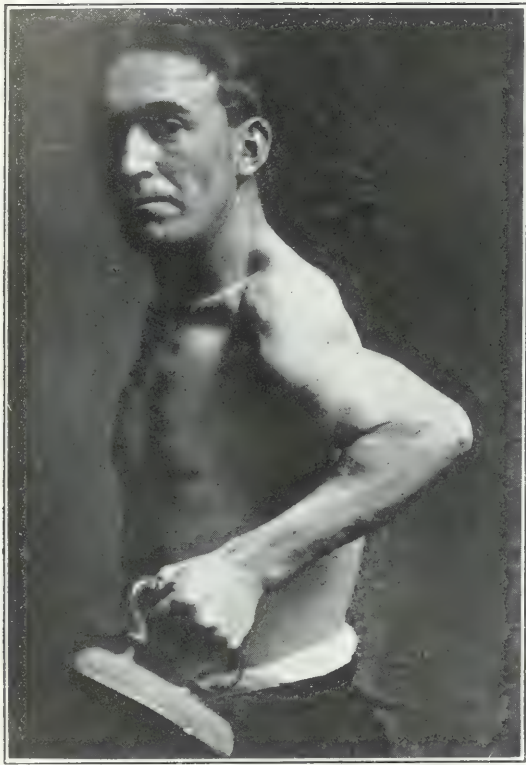


FIG. 7.—Functional result after injury shown in FIG. 6. Flail-joint weakens arm but patient is able to work as freight conductor.



FIG. 8.—Illustrating importance of dealing with wounds of soft parts in case of compound fractures. Patient had a bad compound comminuted fracture following kick by army mule. Complete paralysis of musculospiral nerve which was caught over a small spur of bone in the callus. Patient had complete voluntary extension of the wrist and fingers three months after freeing nerve.



FIG. 9.—Gunshot injury of right forearm with extensive destruction of overlying soft parts exposing extensor tendons; one-third shaft of ulna shot away; about 7 cm. of ulnar nerve exposed. Illustration shows flaps turned from radial to ulnar side of forearm to cover exposed tendons; autogenous grafts obtained by taking two strips of skin from forearm above, under local anæsthesia and snipping into multiple small grafts to cover area from which flap was turned; paralysis of ulnar nerve shown by atrophy of interossei and inability to hold paper by adductors of thumb with right hand. Later at second operation ulnar nerve transplanted in front of condyle of humerus and sutured and pedicle flap from chest to supply skin and soft parts to cover bone graft of ulna, third operation. Good functional arm reported by letter two years after injury.



FIG. 10.—Pedicled flaps from chest to replace extensive destruction of soft parts of forearm. Greater comfort of patient and adequate immobilization by using bander and heavy pads or small pillows and broad adhesive strips instead of plaster-of-Paris.



contracture tends to follow tendon suture with considerable resulting disability. Avoiding incision directly down through skin and sheath and early physiotherapy help to avoid this. Tendon-lengthening by various methods has not given me as good satisfaction as direct suture, even where joints have had to be extremely flexed in order to get apposition of the ends which had been separated for a long time. In injuries of longer standing the use of free fat transplanted under adherent tendons and covering with a pedicle flap, including a fair amount of fat, frequently give excellent results where there has been loss of function because of adhesions. This is, of course, usually avoidable if reconstructive measures can be carried out early. The value of physiotherapy immobilizing fingers and joints which have been stiffened is well enough understood not to need more than mention. The importance of tendon repair is most appreciated by persons who use their fingers and hands for highly skilled work. Among my patients have been a number of musicians, including a cellist, flutist and pianist, who were completely incapacitated from playing their instruments by reason of relatively trifling injuries involving tendons. These patients have been able to play as well as ever in a short time after the suitable measures for repair.

Peripheral Nerve Injuries are common in connection with crushing injuries, gunshot wounds and other causes of compound fracture. The importance of early reconstruction work in these injuries was another of the important lessons taught by the experience of the world war. The records of Dr. E. M. Hummel showed that over 600 peripheral nerve injuries came under observation during nine months following August, 1918, at Ft. Des Moines. Those patients who had had immediate nerve sutures at the front, in several instances, had early return of function. In other instances, partial function was recovered, and in all these cases the secondary operation was made much easier and the prospect of recovery of function greatly improved. Even in case of wounds which became infected the nerve frequently held together, making later reconstruction surgery much simpler. In over 90 per cent. of the cases in which peripheral nerve operations were performed local anæsthesia was used for an hour or more of the tedious dissection which was usually required to free the nerve and its branches from scar tissue. The patients were made the judges of the efficacy of the anæsthesia, and if any complaint was made a general anæsthetic was administered at once. The large majority of the patients were entirely satisfied with local anæsthesia and the work demonstrated to many skeptical reserve officers the possibilities of local anæsthesia in difficult major surgery. Compound fractures with open wounds which came to us infected were rendered relatively bacteria-free within a short time, in many cases, by careful use of the Carrel-Dakin method, making it possible to skin-graft or turn flaps and get rapid and satisfactory healing of the wound and soft parts. Such reconstruction surgery, making possible the restoration of function to muscles and tendons whose

movements are controlled by the injured nerves, is equally as important as the repair of the injured nerve. In discussing peripheral nerve injuries elsewhere I have called attention to this important interrelation of function. In a few cases in which secondary operations were necessary, we demonstrated to our satisfaction the value of transplanted fat in preventing adhesions and pressure on tendons and nerves. In certain doubtful cases neurolysis was done, freeing the nerve from surrounding scar-tissue, and in case it was not possible to place it where readhesion was not almost certain to occur the nerve was surrounded by a fat flap. In several of these cases where function did not return within a reasonable time the injured area was excised and nerve suture done. In these cases, without exception, the transplanted fat was found in good condition and capable of serving the purpose for which it was used. If nerve function can be restored early a great deal of disability from fibrous changes in muscles can be avoided, as well as tedious freeing of contractures by the various means of physiotherapy. Of course, when contracture or stiffness has developed, the physiotherapy is of great value; but by early reconstruction surgery such disability usually can be avoided, with saving of time and frequently the difference between a relatively perfect and imperfect result. The autotransplants of Huber (nerve-grafts) have been shown by experience of several observers to give a fair percentage of successes when too much nerve was destroyed to permit of immediate suture by any method. This statement is made on the basis of personal experience and reports of other reliable observers, with all respect for the opinions to the contrary of some good neurological surgeons.

Bone. The rule should be, "Save all that is possible." Army experience showed many useful extremities following infected compound fracture with comminution into almost innumerable small fragments. Carrel-Dakin treatment is of great value if impossible to clean the wound by excision without too great sacrifice. Covering exposed bone with a flap immediately or early should be done if possible, but recent experience shows considerable exposed bone may recover under Carrel-Dakin treatment and the fragments form a strong shaft. A fairly useful extremity may be obtained even if a considerable part of the shaft of the long bone is destroyed which is not replaced by bone-graft. Methods of fixation depend largely on choice of the individual, but the army type of splint is well adapted for dressing reconstruction cases. Bone-grafting gave uniformly good results in the hands of many surgeons in the war and it scarcely demands extended comment.

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SPECIAL POINTS IN THE TECHNIC OF OPERATIONS ON THE THYROID GLAND

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How Much Gland Shall Be Left? The amount of gland to be left varies according to the type of goiter. A block of hyperplastic gland (exophthalmic), half an inch square, and an inch long, would probably have as much functional value as a piece of colloid gland ten times as large, for the reason that the hyperplastic gland consists almost entirely of large columnar cells, while the colloid goiter is made up mainly of colloid material and a single layer of cubical cells. The amount to be left should in general be the functional equivalent of a normal gland. This would mean only a small portion of an exophthalmic gland; but in the case of a large colloid goiter, a bulk larger than that of a normal thyroid is required because the colloid goiter is not as active as the normal gland.

In our earlier operations we usually erred by leaving too much of the gland. It was only by trial and error that we finally realized that in cases of exophthalmic goiter a very small amount of gland is sufficient.

What Part of the Gland not to Leave. In our earlier series we followed Kocher's advice and removed the larger lobe, leaving intact the smaller lobe, expecting that the readjustment of the trachea, larynx, and the smaller lobe would be satisfactory to the patient. For cosmetic reasons this proved very unsatisfactory to the average American patient and we were sometimes obliged to resect the remaining lobe. Then we resected both lobes—leaving the posterior capsule (C. H. Mayo) and only a portion of the upper and of the lower poles on each side, believing that thus the parathyroids would be well protected, and the gland well distributed. Though this was better than unilateral thyroidectomy, the poles would too often display themselves as lumps. This plan was not entirely satisfactory.

In our first series, unless it was enlarged, the *median lobe was left*. We soon found, however, that occasionally after operation this quiescent lobe increases markedly in size, giving the appearance of an Adam's apple, which in the case of women, in particular, proved unpopular. As a matter of precaution this lobe is now routinely removed.

Line of Division of the Preglandular Muscles. We have dealt with the preglandular muscles in many different ways. A long vertical median incision, depending on lateral traction for exposure of the gland, was soon abandoned, except for adenomata occupying a median position or for small goiters. For laterally developed lobes, and in exophthalmic goiter, the single median division of the preglandular muscles is too often unsatisfactory.

We have tried the high division of the muscle, employed by C. H. Mayo.

For the majority of cases this gives adequate exposure, but in some goiters it does not always give adequate opportunity for the dissection of the lower pole.

It is for these reasons that, when more than a vertical incision is required, we have adopted the transverse division.

Tying the four arteries outside the capsule occasionally results in parathyroid deficiency because of the limitation of their blood supply. In about one hundred cases I made a bloodless, sharp knife separation of the true capsule from the surrounding tissues, whereby the parathyroid and the recurrent nerves were plainly exposed and were, therefore, left anatomically safe. From the anatomical and dissectional point of view, this is a perfect technic; but it has one defect which condemns it—occasionally, although the voice was little or not at all disturbed for some days after the operation, a hoarseness appeared later and persisted in spite of every form of treatment. This was presumably due to involvement of the recurrent nerve in the new scar tissue.

Catching of masses of thyroid tissue by large forceps and then ligating them by needle and catgut *en masse* was tried as a means of minimizing the number of ligatures and cutting down the time of operation. From these two standpoints, this manœuvre proved a great success; but the pulling together of such a mass of tissue occasionally interfered with the voice. This method was, therefore, abandoned and the more detailed method of catching the individual branches of the main vessels with small forceps was adopted.

Turning Out Gland with Finger.—In our earlier series, after the gland was freely exposed, the forefinger was slipped behind or below or above it, and the deeply lying gland rolled out into view, thus greatly simplifying the operation. This did well in most cases, but in the case of a *bilateral*, deeply burrowing goiter, especially if it is wedged tightly in behind the larynx to that considerable force is necessary to dislodge it, the mere traction and pressure and stretching—that is to say, the mechanical abuse of the recurrent nerves—even though they are not torn, may block the passage of nerve impulses and hence may cause an immediate bilateral paralysis of the vocal cords, which will interfere with or completely block the intake of air, necessitating an immediate tracheotomy. Or, in the case of a partial paralysis, respiratory distress may occur after the operation, necessitating the reopening of the wound, even a tracheotomy. The actual number of such *contretemps* may be few; but one such case seems the equivalent of many in the impression it makes, more especially if, following the tracheotomy, broncho-pneumonia and later death ensue in an otherwise sound and curable patient.

There is another objection to this otherwise highly desirable manœuvre—the turning out of a large thyroid from its burrow with the finger, which applies especially to cases in which the lower pole extends into the chest. In such a case everything may be progressing well, the projecting lobe is rolled out carefully, but just as the manœuvre is completed, a large vein, greatly

stretched, tears, and a full stream of venous blood fills the hole vacated by the ousted lobe. The entire field is at once stained and blood-soaked. The particular vessel is not seen. Promiscuous grasping with forceps in this black pool is a gamble. Packing the entire cavity with gauze will quickly arrest the hemorrhage, but meanwhile the mechanical process of gauze packing has torn neighboring, equally thin-walled veins, which are waiting their opportunity to bleed when the gauze is removed. Everyone gets out of this predicament in his own way, and his own way is usually different in each case. The best method is *prevention* by a controlled technic, which implies grasping every vessel in advance of its rupture and the primary separation of the upper attachment of the lobe so that the thyroid will rise spontaneously with but slight *pull* from above, not *push* from below.

Catching and Tying Bleeding Vessels on the Surface of the Trachea.—If the dissection is carried directly on the trachea or larynx, and vessels are so divided that they can be caught only by picking up and tying the peritracheal fascia with the vessel, thus including the sensory nerves which enter the wall of the trachea, the brain interprets this the same as a foreign body in the trachea. There will be irritation, coughing, increased mucus. If there is increased mucus and coughing, a local tracheitis will occasionally develop. A local tracheitis in turn will occasionally terminate in bronchitis. Bronchitis occasionally develops into broncho-pneumonia. Broncho-pneumonia may terminate in death. Thus an innocent ligature may cause death.

Contact with the trachea and the larynx may be wholly avoided by a sharp, bloodless dissection above the line of cleavage, and hence at a sufficient distance from the trachea and larynx to tie the vessels, without including the sensory nerves of the trachea, leaving on the trachea an undisturbed biologic coat. This is a most important point.

Interference with the Mechanism of Swallowing.—In cases in which a growth is thrust backward on each side behind the larynx, and between it and the œsophagus and the pharynx, if the encircling portion of the gland is dislodged with the finger, in some instances there will result interference with the innervation of swallowing; and the consequent difficulty in swallowing may persist for several days. As a result fluids and even solids may enter the respiratory tract, causing paroxysms of coughing and even broncho-pneumonia. A like interference with swallowing may result when the superior thyroid artery escapes and retreats above, just as the inferior artery may retract below. The interference with swallowing is due to the physical injury of the nerves in the catch-as-catch-can process of grasping the vessel. The dissection may be led into this territory without appreciating the risk. Caution and prevention is the only safe method.

Respiratory Obstruction During Operation.—With nitrous oxid oxygen apparatus, oxygen under pressure may be at once given in case of tracheal obstruction. We have seen a collapsed trachea dilated at will with a change in pressure by means of the gas-oxygen apparatus. But if for any reason

tracheotomy is needed, a transverse small opening between the rings with a knife should be made early rather than late. Just as soon as the obstruction is removed, the trachea may be closed with a French curved round needle, and the wound closed as usual. If conditions are favorable the wound may be closed.

Maintenance of a Clear Field.—For every reason the field should be kept clear from the start to the finish. No division of tissue should be made through blood, especially if scissors are being used. We prefer the knife because the division is more definitive and the chance for error much less.

Blood in the Trachea.—If, in an emergency, the trachea be opened the inhalation of blood must be avoided whatever may be the cost in effort and precaution. This is assured by the control of the local field by hæmostats, and by the sheer skill of the first and second assistants. Inhaled blood is very likely to cause death from broncho-pneumonia.

After all these statements regarding the possible sources of error it would seem that a thyroidectomy could not be made satisfactorily; that the possibilities of danger are innumerable, and beset the operator on all sides. But these difficulties cease to be pitfalls the moment the possibility of their occurrence and the manner of their avoidance have been fixed in the mind of the operator and in the minds of his staff. There has been no tracheotomy in our last 1080 operations. By bearing in mind the precautions indicated above we now rarely see any, even the minor, mishaps.

Delayed Closure.—In any serious case the wound is left wide open—completely so, the divided muscles and tissues down to the trachea and larynx and the depths of the wound under the clavicle—and the open wound is dressed with 1-5000 flavine gauze. The advantages of this procedure are:

1. It shortens the time of operation. It may cut off the fatal last minute.
2. There is practically no postoperative pain or discomfort, thus it lessens by so much the postoperative drive.
3. *And most important:* leaving the wound open prevents the absorption of wound secretion. Aseptic wound secretion has always been known to cause some postoperative increase in temperature in normal non-sensitized individuals, but in the hypersensitized exophthalmic goiter patients, this reaction may be multiplied many times and become a raging, destroying fever.

These wounds are closed under analgesia and local anæsthesia without removing the patient from bed, as soon as it seems safe, usually in the afternoon of the same day—sometimes the next morning—occasionally on the second day after operation.

As for infection, the wounds closed on the same day run a course almost

identical with those in which primary closure has been made. There is a slight tendency after the first six hours to increased contamination.

When to Stop the Operation.—If there is any doubt of the outcome *at any point*, that is the moment to stop the operation, tie off the ligatures and dress the open wound with flavine. Whether mistaken or not, the operation can usually be resumed and completed on the following morning.

Deception of the Patient.—Patients are not deceived as to the time of operation. If we have their consent and confidence, we go ahead so carefully, that they are not aware of the day and the hour of operation. But, if a patient demands to know the proposed day and hour, he is told. If, in consequence of this information, his condition becomes unsatisfactory, operation is deferred. This is only an occasional experience. After the strain of one delay, the patient usually is willing to take a passive rôle.

X-ray Treatment in Thyroidectomy.—X-ray treatment does reduce the activity of the thyroid. It is a simple, painless procedure. Then why not use X-ray to the exclusion of other procedures? Because of the following disadvantages:

- (a) The dose required to produce a given effect is at best a guess.
- (b) Relapses are common.
- (c) The delay in unsuccessful cases leads to serious damage to certain organs—the myocardium, liver, nervous system, etc.
- (d) In case of operation later, the scar tissue and adhesions caused by the X-ray are a handicap. The dilemma in the use of the X-ray is: Myxedema or relapse. If the dose is sufficient to kill all the thyroid cells, myxedema results; if the dose does not kill the cells, they recover and there is relapse.

Indications for Ligation.—In this clinic ligation is employed only as a preliminary to thyroidectomy. Double ligation rarely cures, but as is the case after X-ray treatment, there is a tendency to relapse. And when relapse occurs, we have lost the nicest step in the graded operation.

X-ray might be used instead of ligation as a part of a graded operation, excepting for the uncertainty of the extent to which it has destroyed the thyroid tissue.

To What is the Good Effect of Ligation Due?—Certainly not to the diminution of the blood supply, for no matter how soon or how late after ligation the thyroidectomy is performed the local blood supply is found to be diminished but little. In fact, it often seems as if the blood supply after ligation is richer because of all the developed collateral branches. I am of the opinion that the greater part of the benefit from ligation is the result of a break in the nerve supply of the thyroid since the principal sympathetic nerves run in the walls of the superior thyroid arteries.

What is the Indication for Thyroidectomy? Diagnosis of Hyperthyroidism is the Indication for Thyroidectomy.—We believe this because if we wait to try out the rest cure, in that case rest fails to cure, and this is true in too

many cases, and when the rest cure fails the patient has sustained serious additional damage, perhaps permanent damage, to the myocardium, to the liver, to the nervous system; his life has been shortened; the difficulty of the operation has been increased; and much time has been lost.

It is only within recent years that we have been able to put hyperthyroidism in the class with appendicitis as to operability, but now the mortality of thyroidectomy is almost as low as the mortality of appendectomy. In view of the comparatively short stay in the hospital, the slight risk, the inconsequential scar, we are prepared to accept the dictum "*operate on diagnosis.*"

NOTES ON SURGERY OF THE MEDIASTINUM

BY ARNOLD SCHWYZER, M.D.

OF ST. PAUL, MINN.

SURGERY of the mediastinum comes into question in *inflammations*, especially after injury, be it from direct penetrating wounds or from perforations, mostly from the side of the œsophagus. In one such case I found an easy access and good exposure of the *posterior mediastinum* by resecting several ribs near the costovertebral articulation. The pleura could nicely, and without injury, be stripped free. In this way good access was procured. I cannot convince myself that the procedure of Heidenhain is always preferable, where one enters upon the transverse processes of the vertebræ by an incision near the midline and frees the deep musculature of the back toward the side. Heidenhain then removes the transverse processes and the corresponding portions of the ribs. In this manner the danger of injury to the pleura is thought to be more safely avoided. Surely the wound is much deeper and the orientation more difficult. Our case was a septic phlegmonous infection from a foreign body in a child. The operation did not, however, save the patient from the severe sepsis.

Purulent infections of the *anterior mediastinum* apart from direct trauma are mostly due to a breaking down of lymph-glands or to the advance of an abscess which started in the neighborhood. Of each of these two conditions I have seen one example.

One was an abscess along the pericardium on the right side. It originated from a tuberculous chondritis of the fourth, fifth and sixth ribs. It had apparently started on the under surface. The abscess formed a narrow cavity of about 4 or 5 cm. depth along the pericardium. As tuberculosis of the rib cartilage never heals, if only the affected portion is removed, the whole of the affected cartilage was thoroughly excised; iodoform was rubbed into the wound; the wound was closed up to a fine silkworm drain and healing occurred promptly.

The second case was a lymph-gland abscess, taking its origin from what seemed to be one of the right peritracheo-bronchial glands. Poirier and Cuneo mention that the glands of this group, the peritracheo-bronchial glands of the right side, are the most frequently affected ones among the peritracheo-bronchial group. The abscess in our case was located behind the second and third cartilages on the right side. After resecting these we entered the abscess cavity, at the depth of which (perhaps 5 or 6 cm. below the surface) a somewhat melanotic but principally chalicotic necrosed lymph-gland of the size of a peeled almond was fished out. The patient was a stone mason, which explained the chalicosis. There was little organic matter left in the gland; it consisted

principally of grayish grit. Healing after a few weeks. The case became doubly interesting when our patient returned about three years later with a similar condition on the other side. This time the abscess pointed in the sternal notch, near the head of the left clavicle; and after incision we could enter an abscess cavity downward and inward behind the manubrium sterni, again about 5 cm. in depth. Again a necrotic mass came out, though only after about a week. It was a necrotic lymph-gland of the anterior mediastinum, belonging to the group which lie in the angle of division of the superior vena cava into the two innominate veins, and which Bartels (Das Lymphgefäßsystem) describes as lymphoglandulæ anguli anonymi. Healing after six or eight weeks.

Apart from purulent infections the mediastinum may be the seat of quite a variety of pathological conditions, in the detection of which the Röntgen rays are by far the most important though not exclusive agent. The most frequent occurrence is a tuberculous enlargement of the hilum glands in connection with pulmonary tuberculosis. It is important to remember that in children such large lymph-gland masses may often be primary, *i.e.*, without pulmonary findings and probably propagated from mesenteric tuberculosis. Occasionally tuberculosis may affect the mediastinum in the form of a cold abscess with its origin in a vertebra or the sternum. Lues in the form of gummata or massive thickening around trachea or bronchi and the large vessels is not very infrequent. History, Wassermann, and lesions in other parts of the body are of course to be taken into the reckoning. Hodgkin's disease and leukæmia can form very large masses in the mediastinum. Compared with other shadows of the same extent they give the least local symptoms, be they circulatory disturbances, tracheostenosis or difficulty at deglutition.

The *thymus* may be enlarged by simple hyperplasia or it may be the seat of neoplasms, though Hoffmann in Nothnagel's "Specielle Pathologie und Therapie" rightly doubts the possibility of definitely recognizing the exact origin in any advanced tumor of this area. Especially the comparatively frequent appearance of lymphosarcomata in the anterior mediastinum is thought to have its origin in the thymus, but may of course have just as well the lymph-glands of this area as matrix.

Intrathoracic goiters are among the most frequently seen tumors of the upper mediastinum. They represent a most important and interesting surgical subject, but can only be mentioned in passing.

Aneurisms are another affection of prime importance, particularly those of the different portions of the aorta and of the innominate artery. The Parisian surgeon Guinard reported good results in operation for the aneurism of the truncus anonymus by peripheral ligation, *i.e.*, ligation of the common carotid and the subclavian arteries near the aneurismal sac. I operated on one case in this manner and I may be permitted to report it in short. The patient had been kept flat on his back in bed for six months, and for fear

of rupture he had not even been allowed to sit up for a meal or any other function like defecation. The two arteries were ligated at the same session, and ten days after the operation our patient walked about and could go home. He is now well for over eleven years. The one important point in the operation is to ligate the carotid first and then afterward the subclavian, because embolism occurs easily at the moment of ligation of the first artery, apparently due to the suddenly increased pressure, furthermore to the sudden change in the course of the blood stream and of the whirls in the aneurismatic sac.

As a last chapter, the *neoplasms* remain for discussion. The benign ones are much rarer than the malignant tumors. A few *lipomas* are described; they seem to have started underneath the ribs, and at least two of them, I find, grew outward through an intercostal space, and were thus recognized.

The *chondromata*, a very few in number, started from the chest wall. Only their later course of growth will decide their benign or malignant character.

Of *fibromas* Hoffmann found half a dozen, some of which belong to the older literature and are inexactly reported. I shall describe further on a case of fibroma with partly rather cellular areas. Doctor Bell, Professor of Pathology of the University of Minnesota, considers the tumor however a true fibroma.

Over one hundred *dermoids* have been reported. When still small, they are mostly situated behind the sternum. They develop laterally and grow more and more into the pleural cavity, where they may reach an enormous size, even to fill practically one whole pleural space.

Among the malignant neoplasms we find carcinomata, which take their origin mostly from the œsophagus, at times from carcinoma of the breast or from the trachea or the bronchi. Sarcomas and lymphosarcomas are not so very infrequent. The sarcoma makes large nodular masses, generally prominent on one side of the mediastinum. The X-ray shadow has a rather rounded, sharp outline, which according to Sauerbruch (*Chirurgie der Brustorgane*, 1920) is mainly or exclusively seen on one side of the mediastinal shadow. This is due to a principally expansive growth. The lymphosarcomata, on the other hand, with their exquisitely infiltrating character invade and permeate the neighboring organs rather than simply displace them. The lymphosarcomata form more diffuse neoplastic masses, which show on both sides of the mediastinal shadow. Following the lymph channels they enter along the bronchi into the lung fields, where they produce a marked thickening of the shadow of the hilus with branching along the bronchi like in bronchial carcinoma. This ramification is dense and gives an almost mottled appearance. The malignant tumors of the mediastinum are operable only if unusually favorable circumstances are encountered. Burnham, of Johns Hopkins University (*Jour. Am. Med. Association*, September 22, 1917), writes that, so far as he had been able to ascertain, there had never been a surgical

cure of a malignant mediastinal tumor. I could not go through the whole literature of the subject, but found at least one successful case of a spindle-cell sarcoma reported in the *Beitraege zur klinischen Chirurgie*, 1901, p. 774, operated upon by Marwedel in Czerny's clinic. The tumor was situated behind the sternum and was larger than a man's fist. It formed a sharply outlined mass which could be cleanly removed after resection of the manubrium sterni and of short pieces of the first and second ribs. At the time of the report the patient was well, two years and two months after the operation. Another case of sarcoma by the same operator and reported at the same place, had grown into the mediastinum from its primary seat in the major pectoral muscle. Death one year after the operation.

For the present our only hope in nearly all of these cases lies in the Röntgen rays and more especially in radium. Very large doses of radium with sufficient filtering to remove all but the very hardest gamma rays seem necessary, according to Burnham, who reports most remarkable results. He used only those radium rays which were left after filtering with 3 mm. of lead. If the radium can be introduced into the tumor mass, smaller quantities may be sufficient.

I can report a case in this connection:

On February 21, 1917, a gentleman of twenty-six years consulted me for a mediastinal angiosarcoma. The clinical picture was typical. Our patient was cyanosed. His face was puffed up, the eyes glassy, the veins of the neck distended. Pain in the chest was complained of. A moderate but annoying dry cough existed; pulse 125, temperature $99^{\circ}/_{10}$. For many weeks the patient had not been able to sleep in bed or to lie down on account of his dyspnoea. Over the upper part of the sternal region there was a bulging, which was soft to the touch like an angioma. The diameter was about 10 cm. At the periphery you could see tortuous veins. On March 6th, after some X-ray treatment, we gave a few whiffs of ether in sitting posture; tied the peripheral blood-vessels off by interrupted circumferential sutures, made a vertical incision down to the sternum, inserted the radium (50 mg.) into the wound, and immediately packed and compressed. The tendency to bleed was fearful, but compression and some clamps stopped it. The radium was left in only seven hours. Four days later without anæsthetic we made a groove into the manubrium sterni with Luer's gouge bone shears. The bleeding forced us not to go farther. The radium was put into this sternal groove and left in for twenty-three hours. After this the patient felt easier, did not cough as much as before, and began to sleep at night. On March 17th, we went through the sternum and inserted the radium into the retrosternal tumor mass. The tendency to bleed was incomparably less than previously, especially than at the first incision. This time, and one week later, and again after another two weeks, the radium was placed into the wound, each time for about forty-eight hours. In all the patient had 8600 milligram-hours. If we



FIG. 1.—Röntgen plate of tumor.



FIG. 3.—Pharyngeal intubation. The nasal and the afferent outer rubber tubes are connected by a sharply bent lead tube to insure freedom and room for operator.

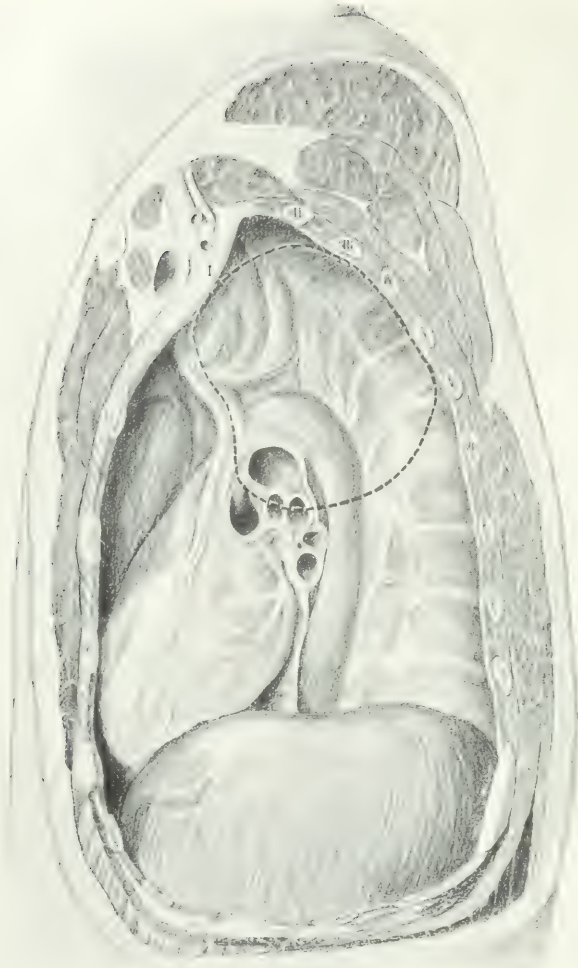


FIG. 2.—Showing location of tumor: dotted outline inserted; plate taken from Corning's Topographic Anatomy.

consider that this dose was given *in* the tumor, it is a very respectable dose and more than is usually given, for instance, in a carcinoma of the uterus. In addition we gave during that time (including two pre-operative treatments) five X-ray exposures (ten to fifteen minutes, hard tube, with 3 mm. aluminum filter). Pain in the left shoulder was complained of for a while, but the general condition was greatly improved. The patient could sleep in his bed, up to eight hours in the night. He went to the theatre, traveled to his home and came back during the eight weeks he was under our care, and was most enthusiastic. Three months later, I was informed that he succumbed to what was declared a pneumonia.

The principal stimulus for this paper was the following case of fibroma of the upper posterior mediastinum:

A cigarmaker of forty-three years, Russian Jew, was referred to me in December, 1919, for stomach trouble and pain in his chest. His history reads: The beginning of the present trouble dates back nine or ten years. He first noticed stinging pain in the heart area. Four or five years ago vomiting started. It only occurred at times and stopped for two years, to come on again in Spring of 1919. The pain around the heart was the same as ten years before, no worse, not all the time. He can walk well, does not get out of breath. His complaints are really quite moderate, and he had consulted his doctor for the stomach condition only. An X-ray of the chest was made on account of the stinging pain in the left side above the heart, and a tumor was found. The patient declares that since about a year ago his voice is not as strong as it was. It gives out quickly when talking. For certain reasons the patient could not take care of his condition at that time. But after pain had set in in the corresponding region on the dorsal side, and had remained constant for three months, he decided to accept the proposed operation.

The tumor was sharply outlined, did not pulsate, showed no definite growth in the four months he was under observation. By a very competent röntgenologist the mass was declared to be probably a malignant tumor and radium treatment was advised. We could not definitely decide between neoplasm and an intrathoracic struma, though the larynx seemed to move at deglutition. It was thought best to go in and see. If we should encounter an abnormally isolated intrathoracic goiter (a true struma accessoria intra-thoracica) or a well walled-off tumor, this was the only proper course to take. If, on the other hand, we had an inoperable malignant tumor, we could insert the radium into its interior, which would be of decided value.

On April 13, 1920, the operation was performed. A low collar incision was made on the neck. The sternohyoid and sternothyroid muscles were cut. The left sterno-cleido-mastoid muscle is also divided in order to get sufficient room and freedom for action. The thyroid is laid bare and found not to be connected downward. A tumor can be felt in the depth. We first try to get near it directly behind the

sternum, but soon find after recognizing the subclavian and left innominate veins, that access was not to be had, and that further advance would lead to tearing the veins. The lower part of the common carotid is then lifted forward with a retractor. The mass appears so hard, sessile and fixed to the left side of the vertebral column, that removal seems doubtful. Some tortuous veins run across its upper pole.

With the idea of possibly reaching an area of safety and line of cleavage for enucleation, or, in case removal was impossible, an access for the introduction of the radium into the centre of the growth, we bluntly penetrate its most superficial fibrous layer with dissection scissors. The region of the thoracic duct is avoided by keeping to the left of it. Positive pressure respiration, which had been prepared for, is now instituted by the aid of two intranasal tubes. The finger can then enter along the anterior surface of the tumor. After progressing about 6 cm. down on the tumor, the finger makes a rent in the pleura. Under the differential pressure the lung is sufficiently ballooned, that we can feel its soft, gently moving, free border. It becomes necessary to get more room. A vertical incision over the sternum enlarges the wound downward. With a finger inserted directly behind the sternum for the protection of the innominate vein a narrow segment of bone is removed with gouge bone shears from the middle of the sternal notch down to the upper border of the second rib. With a sharp bone hook in the head of the clavicle the gap in the sternum can be spread to 3 cm., and the parts are better accessible. After introducing two fingers with considerable force and making use of the cleft in the sternum, the lower pole is felt to be free, while the principal fixation of the tumor is found to be at its upper posterior side. A couple of artery forceps, with one branch inserted into the tumor, give a good hold on it. The fibrous outer layers of the mass are cut between the clamps. The interior proves to be yellowish, broken-down material, partly fluid and partly solid tissue. By crawling down on the tumor alternately with the two forceps and cutting between them the tumor is forced out. A promptly inserted large gauze packing stops the bleeding. Then, in order to obtain a hermetic closure of the pleural space, the cleft in the sternum is covered by a suture of the subcutaneous tissues, and the lower halves of the divided sternohyoid and sternothyroid muscles of the two sides are united in the midline. To make this suture air tight, the lower half of the divided left sternomastoid is dissected free toward its lower attachment and fastened across. The skin is closed up to three small superficial drains. The pulse was good all through the operation, and is 70 at its termination. On the day after the operation a dullness was found over the left side from the angulus speculæ down. This was probably blood and serum. It was left alone. Over the upper portions of the lung nice vesicular breathing could be heard. Recovery was prompt; the exudate cleared away rapidly, and sixteen days after the operation the patient went home. An X-ray picture taken on October 20th gives clear lung fields.*

* X-ray examination in August, 1921 showed again entirely clear lung fields.

SURGERY OF THE MEDIASTINUM

As to differential pressure, it can be said that it was not only helpful in procuring good and easy breathing, but that it was valuable in letting us recognize the amount of the bleeding. With a ballooned lung, which fills the pleural space, the blood shows better in the wound and keeps us informed of the bleeding at every moment and by every move. Not only is overpressure useful for these mentioned reasons, but it becomes indispensable and of prime importance when the possibility of injury to both pleural cavities exists as in operations directly behind the sternum.

Our apparatus was the simplest possible, and for that reason was not likely to fail us in functioning. A Ben Morgan ether chamber, which happened to be the readiest simple outfit at hand, was connected with a good large bellows. We might have used the nitrous oxide and oxygen bombs,

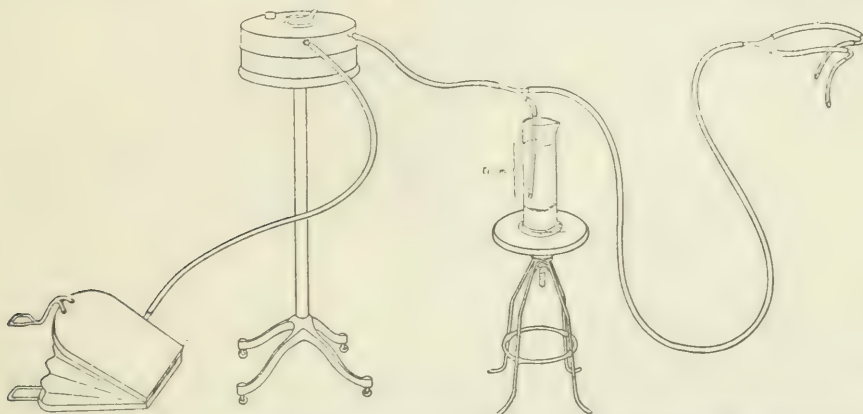


FIG. 4.—Overpressure apparatus for intranasal pharyngeal intubation, improvised with bellows and a Ben Morgan apparatus. The glass tube, which is immersed in water, acts as manometer and safety valve.

and they were in fact on hand, but the bellows would not fail us and would not give out as a bomb will, and no disturbance and interruption by changing of bombs would have to be figured with. The ether chamber was connected by a long, good-sized rubber tube with two intranasal tubes, which are to be inserted down to—but not beyond—the soft palate. Their openings, which are cut off on a slant, are to barely show behind the velum. Between the ether chamber and the intranasal tubes, which are connected by means of a forked glass tube, the long rubber tube is tapped by a T-shaped glass piece. The third arm of it is connected with a straight glass tube, about a foot long, which reaches into a high glass vessel filled with water. This serves as manometer and as safety valve. The glass tube was so fastened in our case, that it entered 22 or 23 cm. below the level of the water. This gave us approximately 17 mm. of mercury pressure, a pressure somewhat too high if the mouth is kept closed tight. An assistant was instructed to work the bellows just enough to produce a gentle bubbling in the water manometer, which assured the proper pressure and let the operator hear that everything

worked well. The anæsthetist could regulate the pressure by closing the patient's mouth more or less firmly with gauze. For obtaining a gentler and more evenly sustained pressure we had formerly prepared a wide connection with a soft rubber balloon of large size, which ought to be close to the patient. As so often happens with rubber goods, the balloon, having long laid idle, was spoiled. We got along well without it, though in a long operation it would be desirable. Instead of the intranasal tubes one could use a well-fitting face mask; but the pressure would not be so even and safe. The ether chamber is not an essential. Its place can be taken by some balloon or tank like container, which steadies the pressure procured by the interrupted action of the bellows. The main tube is then tapped near the patient (as I had arranged it at a previous occasion) by a smaller tube entering from the side, through which ether vapors are pumped in according

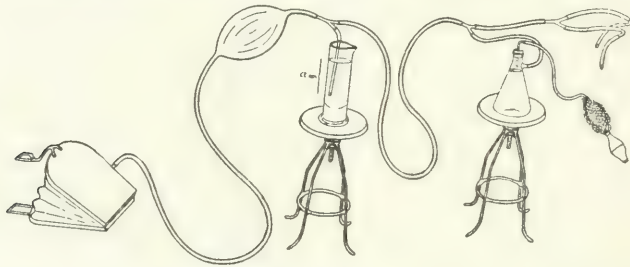


FIG. 5.—Overpressure apparatus for intranasal pharyngeal intubation, improvised with bellows, a large rubber bag and a small rubber bulb pump from a Paquelin cautery for the addition of ether vapors.

to need by the anæsthetist.

If we do not want to introduce a stomach tube beforehand, the epigastrium needs watching for possible distention of the stomach.

What I am particularly anxious to illustrate is the point that some sort of overpressure can readily be improvised. For the occasional operator in this field it is much more important to be ready to improvise some apparatus, even if primitive, than to own a cumbersome outfit, which is stored away somewhere and may be out of order when needed. The difference in results between no apparatus and a primitive one is a good deal larger than between a primitive and an elaborate one.

In our case the differential pressure was not used long enough to produce the otherwise much dreaded shock. The narcosis was quite smooth, as is the rule in overpressure narcosis. Closure of the glottis does not occur or is at least counteracted. Vomiting is practically never seen. I can fully agree with Sauerbruch, that local anæsthesia (in its present form of development) in intrapleural operations is a capital mistake, because "forced and excited breathing, stoppage of respiration and abnormally deep aspiration with all its disturbances and shock" are then very marked.

LIFE EXPECTANCY FOLLOWING RADICAL AMPUTATION FOR CARCINOMA OF THE BREAST: A CLINICAL AND PATHOLOGIC STUDY OF 218 CASES*

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THE study of these cases was undertaken for the purpose of determining, as nearly as possible, the life expectancy of patients on whom primary radical amputations of the breast have been performed for carcinoma. The factors which seem important in determining the expectancy of life were carefully studied from a clinical and a pathologic standpoint in a series of 218 patients with carcinoma of the breast operated on in the Mayo Clinic. The conclusions reached from the clinical findings and the findings at operation are discussed first, the microscopic picture of the tumors removed and the bearing which these different pictures seem to have on the prognosis are next considered.

It is impossible to foretell the duration of life of all patients with carcinoma of the breast, because the degree of malignancy varies widely, and persons react differently to the disease. For instance, certain types of carcinoma of the breast cause death within a few months after they are recognized, and other types metastasize slowly and do not prove fatal for many years; the latter, however, are rare and constitute only a small percentage of carcinomas of the breast. In the majority of these it is possible to make a fairly accurate prognosis with regard to the duration of life following operation.

It was gratifying to find, from our statistics, that the results obtained from early operations for carcinoma of the breast are probably better than those obtained in operating for any other type of malignant growths, with the exception of basal-cell epitheliomas and epitheliomas of the lip. Patients who apply for treatment may be classed in three groups:

Group 1.—Patients with inoperable growths; growths firmly fixed to the chest-wall; extensive ulcerating growths with metastatic skin nodules; fixed masses in the axilla; extensive involvement of the axillary and supraclavicular glands, or internal metastasis. Operation is of no avail and is probably harmful.

Group 2.—Patients who have removable growths, but in whom, because of the extent of the growth, or the glandular involvement, a cure cannot be expected by operation. Operation is often performed from an humanitarian

* Presented before the Southern Surgical Association, December, 1920.

standpoint, without expectation of cure, to relieve future suffering and discomfort.

Group 3.—Patients with removable growths, with or without metastasis in the axillary glands. These patients have a chance for cure through operation. It is the prognosis in this group that we wish to discuss.

By studying the results obtained in 218 cases we found that 51.8 per cent. of the patients operated on, one of each two patients, were living three years after operation. Seventy-five and six-tenths per cent. of the patients without glandular involvement, three of each four patients, were living at the end of three years, and 36.6 per cent. of the patients with glandular involvement, about one of each three patients, were alive at the end of three years. (Table I.)

Thirty-nine per cent. of the patients, about two of each five patients, were alive at the end of five years. Sixty-five and one-tenth per cent. of the patients without glandular involvement, about six of each ten patients, were alive at the end of five years, and 21.9 per cent. of the patients with glandular involvement, about one of each five patients, were alive at the end of five years.

Thirty-six and seven-tenths per cent. of the patients, about one of each three patients, 63.9 per cent. of the patients without glandular involvement, about six of each ten patients, and 18.9 per cent. of the patients with glandular involvement, about one of each five patients, were living from five to eight years after operation.

Of the series of 218 patients, 2.7 per cent. died within six months; 21.1 per cent. died within one year; 34.9 per cent. died within two years; 42.2 per cent. died within three years; 49.1 per cent. died within four years, and 55 per cent. died within five years. Only 2.3 per cent. died after five years. Four and one-tenth per cent. of the patients living from five to eight years after operation have recurrences, and it is probable that these will die from cancer. After eight years the disease rarely recurs.

Carcinomas which developed during pregnancy and during the lactating period invariably proved fatal within five years after operation. Diffuse carcinomas which involved practically the entire breast caused death in every instance within five years; all but one of the sixteen patients with this type of growth died within three years after operation. When the axillary glands were involved, carcinomas around the nipple proved fatal in seventeen of eighteen patients (94.5 per cent.) within five years. Seventeen of twenty patients with ulcerating carcinomas (85 per cent.) were dead at the end of seven years; fourteen died within five years after operation.

Age seems to have a definite bearing on the results to be expected following operation. Forty-one and seven-tenths per cent. of the patients over fifty are alive from five to eight years after operation, while only 31.8 per cent. of those under fifty have lived a corresponding time. The immediate hospital mortality was less than 0.5 per cent.

LIFE EXPECTANCY BREAST OPERATIONS

In our experience the prognosis has not been affected by the complete removal of small growths for microscopic diagnosis before the radical operation is performed. When local recurrences were found following operation, metastasis was demonstrated in other regions in 60.9 per cent. of the cases, or in six of each ten patients. Nearly all patients who had recurrences following operation died from the disease.

RESULTS OBTAINED IN 218 CASES IN WHICH OPERATION WAS PERFORMED

Of eighty-six patients (39.5 per cent.) without glandular involvement, fifty-five (63.9 per cent.) are alive from five to eight years after operation. Six of the patients had recurrences. Thirty-one (36.1 per cent.) are dead.

Of 132 patients (60.5 per cent.) with glandular involvement twenty-five (18.9 per cent.) are alive from five to eight years after operation; three had recurrences, and 107 (81.1 per cent.) are dead.

TABLE I
*Three, Five, and Eight Year Cures (218 Cases) **

Decades.	Pa- tients.	Alive three years after operation.	Alive five years after operation.	Alive from five to eight years after operation.
20 to 30 With glandular involvement ..	3	0	0	0
Without glandular involvement	1	1	1	1
30 to 40 With glandular involvement ..	16	4	1	1
Without glandular involvement	15	11	9	9
40 to 50 With glandular involvement ..	50	17	10	8
Without glandular involvement	25	20	16	16
50 to 60 With glandular involvement ..	28	10	8	8
Without glandular involvement	31	24	22	22
60 to 70 With glandular involvement ..	26	12	8	6
Without glandular involvement	11	7	6	5
70 to 80 With glandular involvement ..	9	5	2	2
Without glandular involvement	3	2	2	2
		113(51.8%)	85(39%)	80(36.7%)
Total...With glandular involvement ..	132	48(36.6%)	29(21.9%)	25(18.9%)
Without glandular involvement	86	65(75.6%)	56(65.1%)	55(63.9%)

* In thirteen cases the exact date of death was unknown.

PERCENTAGE OF DEATHS OF PATIENTS UNDER AND OVER FIFTY, WITH AND WITHOUT GLANDULAR INVOLVEMENT

One hundred ten (50.5 per cent.) of the patients operated on were under fifty; sixty-nine (62.7 per cent.) had glandular involvement, and nine (13.0 per cent.) are alive from five to eight years after operation. Forty-one (37.3 per cent.) were without glandular involvement, and twenty-six (63.4 per cent.) are alive from five to eight years after operation.

One hundred eight (49.5 per cent.) were over fifty; sixty-three (58.3 per cent.) had glandular involvement, and sixteen (25.4 per cent.) are alive from five to eight years after operation. Forty-five (41.7 per cent.) were without glandular involvement and twenty-nine (64.4 per cent.) are alive from five to eight years after operation.

PATHOLOGIC FACTORS IN THE LONGEVITY IN CANCER OF THE BREAST

One of the most important questions involved in the entire subject of cancer is: Why do some patients live longer than others with grossly the same or even less local or general cancer? This question was emphasized in the study of a series of cases of gastric cancer,¹ in which it was found that patients with complete involvement of regional lymphatic glands often lived much longer than patients without regional glandular involvement, although as a general rule postoperative longevity is in inverse relation to the amount of glandular involvement. In one series of gastric cancers it was observed that two factors, cellular differentiation and lymphocytic infiltration, apparently play a part in the defensive mechanism against new growths. Thus patients without glandular involvement and with local lymphocytic infiltration lived, on an average, 124 per cent. longer postoperatively than patients without glandular involvement and without local lymphocytic infiltration, and patients with glandular and with local lymphocytic infiltration lived 146 per cent. longer than patients with glandular involvement without lymphocytic infiltration. The average length of postoperative life was increased 7.5 per cent. in the presence of cellular differentiation. When differentiation and lymphocytic infiltration were both present the average length of postoperative life was increased 82 per cent. These data represent averages and do not apply to all specific cases. As general facts, they give some clue to the defensive mechanism of the body against malignant neoplasms.

In the series of 218 cases of mammary cancer here reported it was found that death had occurred in 138. In ninety-one* of these cases complete pathologic material was preserved and studied in detail from the standpoints of cellular differentiation, lymphocytic reaction, fibrosis, and hyalinization (Tables II, III, IV, and V); the two latter possible defensive factors are in greater evidence in mammary cancer than in gastric cancer.

It will be remembered that neoplasia in the breast manifests itself in three reactions—primary, secondary, and tertiary cytoplasia,^{2, 3}—and that these stages are found with or without the presence of partial cellular differentiation, lymphocytic reaction, fibrosis, and hyalinization, the last three of which, we believe, represent either etiologic factors or a defensive mechanism. The conception that the presence of cellular differentiation is unfavorable to the continued growth of cancer cells is based on the unwritten law in general biology that power of cellular reproduction is inversely proportional to cellular differentiation. If this law is correct, cancer cells which show partial differentiation, as in 15 per cent. of the cases of mammary cancer studied, must of necessity grow less rapidly than cancer cells without differentiation.

The following generalizations may be made from the data studied con-

* All pathologic specimens were studied independently of any knowledge of the clinical histories or postoperative mortality. It was not until the pathologic observations were made and recorded that they were assembled with the preoperative and postoperative histories.

LIFE EXPECTANCY BREAST OPERATIONS

TABLE II
Patients without Glandular Involvement at Operation who died

	Decades												Total
	30 to 40			40 to 50			50 to 60			60 to 70			
	2			5			Patients 7			3			
	Postoperative life												
	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	
Longest.....	4	5	2	5	5	16	4	5	0	3	9	20	
Shortest.....	3	0	22	5	2	14	1	1	16	1	8	22	
Average.....	3	5	19	3	4	9	2	3	11	2	7	23	
Average with local lymphocytic infiltration alone.....				2	4	17				2	2	2	
Average with local lymphocytic infiltration, hyalinization and fibrosis.....	3	5	19	2	5	16	1	1	16	3	3	3	
Average without local lymphocytic infiltration, hyalinization and fibrosis.....				3	3	2				1	3	3	
Average with cellular differentiation.....				3	4	9	2	3	11	2	6	19	
Average without cellular differentiation.....	3	5	19	4	5	10	2	3	16	2	7	23	
Average with local fibrosis.....				4	1	7	2	2	4	1	2	6	
Average without local fibrosis.....	3	5	19	2	2	13	1	1	16	2	5	19	
Average with local lymphocytic infiltration.....	3	5	19	3	6	5	3	5	6	2	9	27	
Average without local lymphocytic infiltration.....	3	5	19	3	5	16	2	1	16	2	5	28	
Average with local lymphocytic infiltration and fibrosis.....	3	5	19	1	3	2	3	1	6	2	3	23	
Average without local lymphocytic infiltration and fibrosis.....	3	5	19	1	3	16	3	1	6	2	3	23	
Average with local lymphocytic infiltration and hyalinization.....	3	5	19	5	5	2	3	5	12	2	8	23	
Average without local lymphocytic infiltration and hyalinization.....				1	3	10	2	2	6	2	5	28	
Average with local hyalinization.....	3	5	19	4	5	7	2	1	12	2	2	19	
Average without local hyalinization.....				1	1								

TABLE III
Patients with Glandular Involvement at Operation who died

	20—30	30—40	40—50	Decades 50—60	60—70	70—80	Total
	Cases.						
Without cellular differentiation	3(100%)	9(90%)	28(90%)	12(92%)	14(100%)	2(66.66%)	68(91%)
Without local lymphocytic infiltration	1(33.33%)	2(20%)	10(33%)	4(30%)	7(50%)	1(33.33%)	25(33%)
Without local hyalinization	2(66.66%)	6(60%)	17(54%)	5(37%)	6(42%)	0	36(48%)
Without local fibrosis	2(66.66%)	3(30%)	9(29%)	3(23%)	6(42%)	0	23(31%)
With local lymphocytic infiltration and local fibrosis	1(33.33%)	6(60%)	14(45%)	7(53%)	3(21%)	2(66.66%)	33(44%)
With local lymphocytic infiltration and local hyalinization	1(33.33%)	4(40%)	8(25%)	5(37%)	2(14%)	2(66.66%)	22(29%)
With local hyalinization and fibrosis	1(33.33%)	4(40%)	14(45%)	8(60%)	7(50%)	3(100%)	37(50%)
With local lymphocytic infiltration, hyalinization and fibrosis	1(33.33%)	4(40%)	8(25%)	5(37%)	2(14%)	2(66.66%)	22(29%)
<i>Patients who Died and who were without Glandular Involvement at the time of Operation</i>							
Without cellular differentiation	2(100%)	5(100%)	0	2(66.66%)			9(52%)
Without local lymphocytic infiltration	0	2(40%)	6(85%)	2(66.66%)			10(58%)
Without local hyalinization	0	2(40%)	3(42%)	1(33.33%)			6(35%)
Without local fibrosis	0	2(40%)	2(28%)	0			4(23%)
With local lymphocytic infiltration and local fibrosis	2(100%)	1(20%)	1(14%)	1(33.33%)			5(29%)
With local lymphocytic infiltration and local hyalinization	2(100%)	1(20%)	1(14%)	0			4(23%)
With local hyalinization and fibrosis	2(100%)	3(60%)	4(56%)	2(66.66%)			11(64%)
With local lymphocytic infiltration, hyalinization, and fibrosis	2(100%)	1(20%)	1(14%)	0			4(23%)

Total Number of Patients Dead

Without cellular differentiation	77(84%)
Without local lymphocytic infiltration	35(38%)
Without local hyalinization	42(46%)
Without local fibrosis	27(29%)
With local lymphocytic infiltration and local fibrosis	38(41%)
With local lymphocytic infiltration and local hyalinization	26(28%)
With local hyalinization and fibrosis	48(52%)
With local lymphocytic infiltration, hyalinization, and fibrosis	26(28%)

LIFE EXPECTANCY BREAST OPERATIONS

TABLE IV
Patients with Glandular Involvement at Operation who died

	Decades												Total														
	20 to 30			30 to 40			40 to 50			50 to 60				60 to 70			70 to 80										
	3			10			31			Patients 13				14			3			74							
Postoperative life																											
	Years			Months			Days			Years			Months			Days			Years			Months			Days		
	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days			
Longest	3	1	10	4	0	3	7	0	0	3	6	5	0	1	8	0	5	4	7	0	0	3	3	11			
Shortest	0	7	0	9	5	18	0	4	4	6	1	3	0	8	5	2	3	10	8	1	5	17	5				
Average	1	6	21	2	3	16	2	4	4	14	1	3	2	2	3	4	9	2	7	1	4	11	11				
Average with local lymphocytic infiltration	3	1	0				1	5	5	15	2	8	5	2	4	9			3	2	4	5	11				
Average with local lymphocytic infiltration, hyalinization, and fibrosis	1	0	4	1	5	4	3	3	3	17	2	3	12	1	3	25	2	5	5	1	5	11	11				
Average without local lymphocytic infiltration, hyalinization, and fibrosis	1	7	0	1	5	2	1	5	11	0	3	14	3	4	27	2	25	8	4	1	5	18	12				
Average without cellular differentiation				3	0	0	3	3	5	20	4	4	12	2	3	10	4	4	3	3	5	15	15				
Average with local fibrosis	1	6	21	1	7	11	0	1	3	8	1	3	12	2	3	10	2	4	4	1	5	18	13				
Average without local fibrosis	1	0	4	1	10	3	2	4	4	10	1	1	14	2	14	13	2	2	3	1	5	15	15				
Average with local lymphocytic infiltration	2	0	17	2	5	8	2	4	4	16	1	2	6	2	2	15	2	5	5	1	5	13	13				
Average without local lymphocytic infiltration	0	7	0	1	7	10	2	5	14	2	4	12	1	4	13	3	21	8	5	1	6	13	12				
Average with local lymphocytic infiltration and fibrosis	1	0	4	2	5	14	2	2	5	14	1	4	13	1	3	21	2	8	5	1	6	12	12				
Average without local lymphocytic infiltration and fibrosis	1	7	0	1	9	16	3	3	3	17	2	3	12	3	3	25	2	8	5	1	5	16	15				
Average with local lymphocytic infiltration and hyalinization	1	0	4	1	9	16	1	5	11	3	2	3	14	3	2	25	2	8	5	1	6	12	12				
Average without local lymphocytic infiltration and hyalinization	1	7	0	2	9	16	2	5	16	2	1	2	14	4	2	14	2	5	1	6	15	14	14				
Average with hyalinization	1	0	4	2	9	16	2	3	3	16	1	3	14	3	2	25	2	8	5	1	6	12	12				
Average without hyalinization	1	7	0	1	4	7	2	3	5	12	3	3	16	2	4	14	2	8	5	1	5	11	11				

cerning ninety-one patients who died in the series of 218 patients with mammary cancers:

1. Cellular differentiation occurred in 8.6 per cent.
2. Local lymphocytic infiltration occurred in 62 per cent.
3. Local hyalinization occurred in 54 per cent.
4. Local fibrosis occurred in 71 per cent.
5. Lymphocytic infiltration and fibrosis occurred in 41 per cent.
6. Lymphocytic infiltration and hyalinization occurred in 28 per cent.
7. Hyalinization and fibrosis occurred in 52 per cent.
8. Lymphocytic infiltration, hyalinization, and fibrosis occurred in 28 per cent.
9. The average length of postoperative life of patients with local lymphocytic infiltration alone was 28 per cent. greater than the average length of postoperative life of the ninety-one patients.
10. The average length of postoperative life of patients without local lymphocytic infiltration was 15 per cent. less than the average length of postoperative life of patients with local lymphocytic infiltration.

TABLE V
Postoperative Life of Patients Dead (Ninety-one)

	Years	Months	Days
Longest	7	0	3
Shortest	0	3	5
Average	1	8	24
Average with local lymphocytic infiltration alone	2	2	16
Average with local lymphocytic infiltration, hyalinization, and fibrosis	2	4	17
Average without local lymphocytic infiltration, hyalinization, and fibrosis	1	4	17
Average with cellular differentiation	2	8	18
Average without cellular differentiation	1	8	22
Average with local fibrosis	1	10	13
Average without local fibrosis	1	3	20
Average with local lymphocytic infiltration	1	7	22
Average without local lymphocytic infiltration	1	10	20
Average with local lymphocytic infiltration and fibrosis	1	8	23
Average without local lymphocytic infiltration and fibrosis	1	8	21
Average with local lymphocytic infiltration and hyalinization	2	4	19
Average without local lymphocytic infiltration and hyalinization	1	8	20
Average with local hyalinization	1	10	14
Average without local hyalinization	1	6	21

11. The average length of postoperative life of the patients with lymphocytic infiltration, hyalinization, and fibrosis was 37.8 per cent. greater than the average length of postoperative life of the ninety-one patients as a group.

12. The average length of postoperative life of patients without lymphocytic infiltration, hyalinization, and fibrosis was 42 per cent. less than the average length of postoperative life of patients with lymphocytic infiltration, hyalinization, and fibrosis.

13. The average length of postoperative life of the patients with cellular

differentiation was 57 per cent. greater than the average length of postoperative life of the ninety-one patients.

14. The average length of postoperative life of patients with fibrosis was 7 per cent. greater than the average length of postoperative life of the ninety-one patients, and 42 per cent. greater than that of the patients without fibrosis.

15. The average length of postoperative life of patients with lymphocytic infiltration and hyalinization was 44 per cent. greater than the average length of postoperative life of the ninety-one patients.

16. The average length of postoperative life of patients with fibrosis and hyalinization was 1.48 per cent. greater than the average length of postoperative life of the ninety-one patients, and 4.87 per cent. greater than the average length of postoperative life of patients without fibrosis and hyalinization.

CONCLUSIONS

1. The three greatest single factors in increased postoperative longevity of the ninety-one patients with mammary cancers are cellular differentiation, hyalinization, and fibrosis.

2. Lymphocytic infiltration alone does not appear to be the main factor.

3. It appears that while hyalinization and fibrosis play, individually, some part in increasing longevity in cases of cancer of the breast the two greatest known combined factors are cellular differentiation and hyalinization.

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THE TRANSVERSE ABDOMINAL INCISION

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WITH the exception of colostomy and gastrostomy, all intra-abdominal operative procedures are of comparatively recent date; but, in spite of that fact, the literature on abdominal surgery is probably more voluminous than in any other branch of surgery.

From the "anæsthesia" point of view, the work of Simpson and Morton made major surgery possible; but it remained for Lister to make the surgery of the body cavities not only possible but safe.

One of the greatest living surgeons and pioneer of abdominal work said that it was almost criminal to cut any of the muscles of the abdominal wall; and therefore all abdominal incisions were planned so that they ran in the plane of the muscle fibres, allowing of their separation, and so that the interior of the abdomen, with its contents, could be explored. This was held, by the majority of the surgeons, as an accepted fact for many a long day; and it remained for Maylard to give us the transverse incision, which, in many instances, has rendered intra-abdominal manipulations, which were previously regarded as some of the most difficult, the easiest operations in surgery.

The history of the evolution of the transverse incision is interesting. It is not certain as to who was the first to practice the transverse incision of the abdominal wall; Bardenheuer is given the credit by some.

In 1896, Kustener made a transverse incision of the skin for the performance of a certain gynæcological operation, and at the time, but unknown to Kustener, Rafain, another gynæcologist, had elaborated the same technic.

In 1900, Stimson reports having made use of a combined longitudinal and transverse abdominal incision; and, also in 1900, Pfannenstiel independently introduced a transverse incision through skin and fascia, in gynæcological work, which he called the suprasymphyseal transverse fascial incision.

Naudet, working in the clinic of Professor Hartmann, of Paris, published results of the use of a transverse incision through skin and fascia.

But the real transverse incision through the complete thickness of the abdominal parietes, and in any part of the abdominal wall, was introduced by Maylard, of Glasgow, in 1898.

The history of what led to Maylard's introduction of this technic begins with the observations made by him, in his treatment of a gastric case. He had operated upon a man's stomach by the ordinary median longitudinal supra-umbilical incision; but, a few days later, it was found to be necessary to reopen the abdomen, and in view of what was found, more room for the performance of the intra-abdominal operations was found to be necessary; the

THE TRANSVERSE ABDOMINAL INCISION

right rectus abdominis was therefore cut across. As a result, it was found that the union of the transverse part of the incision was excellent, but a post-operative ventral hernia developed in the longitudinal part of the scar.

After this result, and following upon the observations made in a comparison between the longitudinal and the transverse incisions, Maylard, a few years later, came ultimately to adopt the "transverse incision" of the abdominal wall, as a routine method for all intra-abdominal operations.

Moschcowitz, in the *ANNALS OF SURGERY*, September, 1916, part 265, says that at the date of writing the paper he had examined all his cases, and had not found one single case of ventral hernia. It is to be noted that Moschcowitz did not make his first transverse incision until August 2, 1910, or twelve years later than Maylard.

In the *ANNALS OF SURGERY*, February, 1918, part 302, J. W. Churchman describes a new incision for exploration of the lower abdomen; this incision is in the form of a Y, but according to the author is not applicable generally, but only to the pelvic branch of abdominal surgery.

After this brief résumé of the history of the transverse incision, I will now deal with the subject under various headings.

ESSENTIALS OF AN ABDOMINAL INCISION

1. It should be so planned that the maximum amount of intra-abdominal freedom is obtained, with the minimum amount of damage to nerves and muscular tissue.

2. The incision should be in such a position, and of such dimensions, that the use of retractors is reduced to a minimum.

3. It should be such that complete temporary muscular relaxation is obtained, because then retraction becomes unnecessary, and shock will be less, since the stimulus necessary for the production of the abdomino-visceral reflex, the connecting link between the abdominal wall and the intra-abdominal organs, is absent.

4. The shock should be as little as possible, with therefore less liability to primary and reactionary hemorrhage.

5. The margins of the incision should tend to fall together.

6. It should be capable of closure, without strain being put upon the constituent parts of its margin.

7. When suturing is complete the margins should be in such a position that the various tissue elements are placed directly opposite each other, so that any exertion on the part of the patient tends to bring them closer together and not further apart.

8. The amount of scar tissue produced should be as small in quantity as possible, and so placed that while it acts as a connection between the severed ends of the various tissues, it should have at no time any mechanical or supporting function required of it.

9. The amount of severance of, or injury to, nerves should be as little as

possible, so that the abdomino-visceral arcs be left proportionately intact, with little resulting muscular paralysis.

Anatomically, the abdominal wall is composed chiefly of several layers of long, flat muscles—three laterally and two median. These, together with the skin, fascia, subperitoneal tissue, and the peritoneum, form the abdominal wall.

There is nothing peculiar in regard to the muscles forming the abdominal wall, but the recti and their respective sheaths. These muscles are peculiar, in that they are formed of two distinct sets of fibres; one set forming, approximately, one-third of the total mass of muscle, which stretches without interruption from its origin to insertion and therefore its actions are, as far as that portion of the muscle is concerned, between these two points; the remaining two-thirds of the muscle, however, show three, sometimes four, fibrous intersections—the lineæ transversæ. These lineæ transversæ are firm fibrous bands, intimately associated with and adherent to the posterior surface of the anterior wall of the sheath of the rectus abdominis. Their function is most probably to provide intermediate points for force and resistance to allow of the recti performing what is called segmental action. By this means it is possible to increase or diminish the abdominal tensions, in any or all of the upper, middle, or lower divisions of the abdomen. This has a very important bearing upon the transverse incision of the rectus and its sheath, and the other abdominal muscles, because the result of such an incision is simply the formation of another linea transversa.

The mode of formation of the rectus sheath is well known, and it is well to remember that its contents are the superior and deep epigastric vessels, with their branches and tributaries, so that to secure efficient hæmorrhage, two sets of ligatures, one pair on each side, will be at least required.

Accepting the fact that, when the nerve supply to any muscle is damaged or destroyed, that muscle atrophies to a greater or lesser extent, it is most important that all abdominal operations that require interference with muscles should have their incision so planned, that there will be the least possible interference with the nerve supply of those muscles.

The nerve supply of the abdominal muscles is derived from the seventh, eighth, ninth, tenth and eleventh intercostal nerves, the subcostal nerve, the inguinal, and the hypogastric branches of the ilio-hypogastric nerve.

The course of these nerves, from their origin to their distribution, is such that, while not transverse, it is only very slightly oblique. They run forward and inward, between the muscle planes, and perforate the posterior wall of the sheath of the rectus at its outer border, and then the anterior wall of the rectal sheath, in its outer part, prior to becoming cutaneous.

It is thus seen that from an anatomical point of view any incision made vertically, and parallel to the middle line of the body, must, according to its length, cut one or more of these nerves completely; the amount of nerve injury involved in the longitudinal incision is great; with the transverse incision the risk of damaging to any great extent the nerves supplying the musculature

of the abdominal wall is small; the incision is running practically with them in their course, and for that reason the incision is anatomically correct.

Physiologically, the action of the abdominal muscle is well known, and does not merit further discussion, except in that it is more than probable that its function of maintaining the abdominal contents in position is much overestimated.

It is, and has been, held that if a muscle of the abdominal wall is injured or cut a ventral hernia will be produced; such in many instances is not the case. Every now and again one sees, after a longitudinal incision has been made in the sheath of the rectus muscle, and the patient unexpectedly strains, that the rectus bulges into the wound, showing how little real power it possesses of maintaining the contour of the abdominal wall, or of retaining the intra-abdominal contents in their various positions.

Now and again, while working through a longitudinal incision, and should the patient be allowed to come partially out of the anæsthetic, it is noticed that the muscles tend to separate and not to come together; with the result that the opening in the abdominal wall is markedly enlarged, and the intestines are protruded. If, however, the incision be a transverse one, it is observed that the margins of the wound, under like circumstances, come together and prevent the escape of the abdominal contents. This is easily understood when it is remembered that a muscle acts from origin to insertion, and in the long axis of its fibres.

The real factors, in the maintenance of the integrity of the abdominal wall and the position of the intra-abdominal contents, are the fascial sheaths.

The *histology* of fascia is also well known and agreed upon; doubtless also are its nourishing, limiting, and protecting powers; but it has not generally received adequate amount of recognition for the invaluable function it performs, in maintaining the integrity of the abdominal wall and retaining the abdominal contents in the abdominal cavity.

One naturally concludes, from experience of other such similar structures in various parts of the body that have a not too liberal blood supply, that its regenerative powers, owing to its poor blood supply would be relatively weak; but such, curiously, is not the case. Not only does it heal with great rapidity after it has been incised, but the union in the majority of cases is extremely firm; and this is probably due to the fact that it is composed of tissue elements which are not highly differentiated in structure.

Sound and firm union is, in the large majority of cases, further proved, when one has to reopen an abdomen after a transverse incision has been used; when it is almost invariably found that all that remains is a narrow firm line of strong fibrous tissue, uniting the cut ends of the muscle.

Pathologically, the remarkable healing properties of the abdominal fasciæ and sheaths, after being transversely incised, are probably explained as follows: All wounds heal by means of tissue which is reproduced from preëxisting mesoblastic tissue; in an aseptic wound a minimum amount of it is produced, but in a wound in which from any cause the healing process is delayed a

maximum amount of it is produced. Granulation tissue in large amount is not desirable, because its elastic properties are deficient and of poor quality. Any of the many factors that delay the healing process in wounds, if present, will cause a large amount of it to be produced, and the presence of blood-clot is probably the most common, due to incomplete hæmostasis at the time of operation. Blood-clot is a foreign body, and has no powers of regeneration or support; it simply keeps apart the edges of the wound and delays the healing process.

What is necessary is not the presence of blood-clot in the wound, but a plentiful supply of blood-vessels in the immediate vicinity, from which new vessels can be produced at the same time as regeneration is progressing in the other tissue elements of the incision.

The course of the blood-vessels is at right angles to the incision; and budding is said to take place more rapidly when a vessel is cut at right angles to its long axis than when partially torn or cut obliquely along with several of its branches; if it is cut straight across, there is no damage done to its branches, which are left unimpaired and ready to form a collateral circulation.

Therefore, the more perfect the mechanical closure of the wound in regard to the coaptation of the surfaces of the cut tissues, the more perfect will be the healing process.

It often happens, however, that no matter how careful one may have been in this suturing, a dead space develops, in which serum, etc., gathers, keeping the cut surfaces apart, and delays or prevents the permanent closure of the wound. This is now and again seen with the longitudinal incision, but practically never where the transverse incision has been used. The reason is that should the suturing in the transverse incision give way, the natural tendency for the edges of any transversely placed abdominal wound is to come together and not to separate. Further proof of this statement is found in the consideration of the normal physiological action of these muscles; and this is the flexion of the thorax upon the pelvis.

Site of Incision.—This depends upon the object of the operation. In the case of an exploratory laparotomy, one, just immediately above or below the umbilicus, has been found to afford comparatively easy access to all parts of the abdominal cavity.

In the majority of cases the operation is one of selection; and then, for purposes of description, one may divide the abdominals into two groups—the supra- and infra-umbilical incisions; or into three, the supra-, infra-, and trans-umbilical, with excision of the umbilicus.

These incisions vary in size, according to the nature and extent of the operation; their average length is about four inches, but this is sometimes considerably exceeded.

Preparation of the Patient.—There are many methods of preparation in use, but that usually adopted by the writer, except in emergencies, is as follows:

If possible, get the patient into hospital two days prior to operation, and

put on a low diet. Have the bowels thoroughly well "moved." The diet is gradually curtailed, so that for the twelve hours prior to the operation nothing but fluids is given. It is found that when two or three days' preparation has been made, the post-operative convalescence is much more rapid.

The patient upon admission is bathed, after which the skin is washed with sterile soap and water, thoroughly dried, and then washed with spirit. Turpentine is then used to dissolve out the fatty matters in the skin, and thoroughly dried off. A piece of white lint soaked in a one-to-forty carbolic acid solution is then applied to the part, and changed every twelve hours, the last change being two hours before operation, when a one-to-twenty carbolic compress is applied, and not removed until the patient is on the table. Immediately before the incision is made, the part is thoroughly washed with spirit.

In an emergency case the skin is prepared as before, but acetone is used in place of the spirit, and the part then swabbed with a five per cent. alcoholic solution of iodine.

Iodine is objected to by many surgeons on the ground that some of the viscera are almost bound to come into contact with it, and, as a result of its action on peritoneal surfaces, post-operative abdominal adhesions are said to be more frequent than after many of the other forms of preparation.

Method of Incising.—The skin is firmly fixed between the first and second fingers, and a clean cut made through skin and subcutaneous tissue down to the muscle sheath. This is next incised and the muscle cut through. All bleeding points are now secured and the peritoneum opened. It is most important that a complete hæmostasis should be obtained. The round ligament of the liver is clamped between pressure forceps and then cut through; it is sutured separately. After the peritoneum is opened all bleeding points are ligatured. As a rule, four ligatures only are required, two on each side, for the superior or deep epigastrics, according to the part incised. And, as a rule, ligatures are not required for vessels in the subcutaneous tissues, pressure forceps being left on them until the peritoneum is opened; these are then removed, the pressure being usually found sufficient to produce complete hæmostasis.

Mr. Maylard has always objected to the spending of too much time in the ligation of every bleeding point, believing that in so doing there would be too much capillary occlusion, and the edges of the wound, after coaptation, would fail to be rapidly and freely supplied with blood.

Method of Closure.—Upon completion of the operation the peritoneum is grasped at either extremity of the incision, and on either side at its centre, by handled artery forceps. These are used in preference to pressure forceps because they exert no pressure upon the part grasped, and small areas of post-operative necrosis are thus less likely to occur.

In closing the peritoneum, Mr. Maylard grasps the end at which he will commence to stitch with two sharp single hooks, and when the first stitch has been secured, their further use is dispensed with.

The two ends of the round ligament are first firmly sutured together by one small mattress suture.

Under ordinary circumstances three layers of sutures are required to close the wound in the abdominal parietes; the first includes peritoneum and the posterior wall of the sheath of the rectus; the second, the anterior wall of the sheath of the rectus, including also the posterior wall, should there be any doubt about the hæmostasis; and the third a layer of sutures for the skin.

The technic of the introduction of these sutures is as follows: The peritoneum is closed by interrupted sutures of catgut, placed one-quarter of an inch apart from each other, great care being taken so that the cut edges of the peritoneum are everted and not inverted; if such be allowed to take place, post-operative abdominal adhesions are not only a possibility, but practically a certainty.

On the introduction of the suture, the knot is tied; the assistant grasps the double ligature one inch from the knot, and cuts it, one by one, as required, until the incision is closed.

The posterior wall of the sheath may have a separate row of interrupted sutures, but this is not really necessary.

The usual method is to use an interrupted suture, which is passed from the anterior surface of one rectus sheath, and brought to the anterior surface of the rectus sheath of the other side of the incision; this suture includes both layers of the rectus sheath and the contained rectus muscle. Before bringing the edges of the skin together the wound is thoroughly swabbed with iodine. This procedure is delayed until all the layers of the abdominal wall have been brought together, except the skin, so that there is no possibility of any of the iodine entering the abdominal cavity; and its object is the sterilization for any possible infection of the edges that might ensue during the various manipulations of the internal parts.

The skin may be closed by either a continuous catgut suture, an interrupted silkworm gut suture, or by Michel's metal clips.

When closed by a continuous catgut, and before the suture is tied, a gauze swab is taken, and rolled firmly along the whole length of the incision, so as to force out any blood or serum which may have collected between the edges during the closure of the wound. After this has been done, the suture is firmly knotted and a collodion dressing applied. When closed with clips or interrupted silkworm sutures, an anchor dressing is applied to the wound.

If the abdominal wall is very thick, a combined superficial and deep continuous catgut or silk stitch is used. This stitch has been used by Maylard for many years, but only recently has any publication dealing with the method been observed.

In *ANNALS OF SURGERY*, February, 1918, part 302, Sir J. O'Connor, K.B.E., of Buenos Aires, describes what he calls the Gallo stitch, for closure of the skin of the abdominal incision. It would therefore be more correct to call

it the Maylard-Gallo stitch, or method of uniting the superficial margins of abdominal incisions.

Take a length of catgut and fix it at one end of the incision in the usual way; then enter the needle half an inch from the margin of the incision, carrying it down to its floor, and bring it out at a point exactly opposite that of entry, and at the same distance from the wound margin. The next stitch is the superficial one, the needle being entered one-eighth of an inch from the wound margin, taking only the thickness of the skin, and bringing it out at a point directly opposite to, and at the same distance from, the wound margin. This makes a most excellent suture, and by means of it subcutaneous and deep oozing are reduced to a minimum.

The anchor dressing consists of six-ply of butter gauze, rolled firmly together the required length, soaked in a one-to-seventy carbolic acid solution, and laid along the line of suture. No medicated gauze of any description is used, simply plain, white, sterile gauze.

When the abdominal wall is very fat, or when a ventral hernia has been dealt with, deep through-and-through silkworm gut sutures are used in the following way: A No. 6 silkworm gut is threaded on a large curved cutting needle; the needle is entered at from one-half to three-quarters of an inch outside of the cut margin, and is directed downwards obliquely towards the floor of the wound, which it crosses, and enters the opposite side, where it is carried through the subcutaneous fat for one inch; it then reënters the edge of the same side, and makes its exit through the skin, at the same distance from the wound, and about one inch from the point of entrance.

The method of tying these sutures is as follows: Three turns are taken, and the suture tightened to the required degree; either end is then separately taken and passed underneath the suture by means of a pair of dissecting forceps, grasped on the other side, and pulled through the loop left at the commencement of the procedure. By this means dragging on the skin and subcutaneous tissues is obviated; there is no tendency for the suture to cut into the skin, causing pain to the patient, and necrosis of skin and subjacent subcutaneous tissues.

By means of this stitch all possibility of a dead space existing between the edges of the wound is obviated.

The stitches are removed in from five to eight days after operation. To remove them, lift one end with a pair of dissecting forceps, and cut the strand between the knot and the skin; if this be done they are most easily removed; the important point to remember is that they must be cut at one or either end, between the knot and the skin, and not in the centre.

It is well to remember that when closing a transverse abdominal incision the patient, after the peritoneum has been closed, should always be raised to the horizontal position, prior to inserting the sheath or skin stitches; if this simple rule be borne in mind a great deal of time and trouble will be saved, since the edges of the wound tend naturally to come together.

If from any unfortunate circumstance it should be found necessary to drain either the peritoneum or the wound, it is done as follows:

A piece of rubber drainage tube of the required size is cut a quarter of an inch longer than the thickness of the abdominal wall, and stitched into the skin at one or other lateral extremity of the wound with the end of the gauze drain brought through it, the diameter of the tube to be according to the size of the drain required; thus, if one have primary reason to pack any part of the abdominal cavity for the control of hemorrhage, a large-sized tube is used; but if the requirement be, say the drainage of an abscess cavity, a tube of a quarter of an inch in diameter would be quite sufficient. The reason for the drainage gauze being brought through a relatively rigid channel is, that if it were simply brought out between the layers of the abdominal wall, it would undergo contraction; on the principle of capillary attraction drainage would be impossible. It should also be noted that when gauze is used for drainage it is thoroughly soaked in bismuth paste; this adds immensely to its drainage powers. Occasionally, as when one has operated for a large ventral hernia, a cigarette drain is laid along the muscle sheath, and brought out at one extremity of the wound; this is removed at the end of the third day. All of these gauze drains are thoroughly permeated with a thirty-three per cent. bismuth carbonate paste, which renders it markedly antiseptic, increases its powers of drainage, by assisting capillary attraction, and prevents the gauze from becoming adherent to bowel or peritoneum. There is also a strong possibility that it helps markedly to prevent the formation of intra-abdominal adhesions, and there is no doubt that gauze thus treated has not the irritating effect upon intestine that dry gauze has; also doing away with what in many cases would appear to be a contributory cause in the formation of a fecal fistula.

ADVANTAGES AND DISADVANTAGES OF THE TRANSVERSE INCISION

Advantages

1. Anatomically and physiologically correct.
2. Does not destroy the nerve supply of the muscles.
3. The muscular fibres being cut at right angles to their long axes, healing is more rapid and thorough.
4. Almost perfect apposition of the wound surfaces after suturing, it being the natural tendency of the margins of the wound to come together so that there is practically no strain put upon the sutures at any time.
5. As the fibres forming the anterior wall of the sheath are running transversely, and the stitches are entered at right angles, the risk of tearing of the fibres is greatly lessened.
6. Easy access to any part of the abdominal cavity.
7. Retractors rarely if every necessary; therefore surfaces of wound not bruised or injured.
8. Less shock to patient, owing to absence of retraction of margins of incision.

9. Abundance of room, and complete freedom for all abdominal work.
10. Complete view of abdominal cavity and its contents; therefore the risk of swabs or instruments being left behind almost nil.
11. Easy delivery and replacement of viscera.
12. No tearing of peritoneum when being closed.
13. Practically perfect apposition of margins of wound; therefore no dead space for post-operative blood-clot, or serum, to collect and delay the healing process.
14. As the line of incision is in one of the lines of cleavage of the skin it is, after a few weeks, almost unobservable.
15. Very little if any post-operative pain.
16. If the patient be sick at any time subsequent to the operation, the pain in and around the incision is very slight, because the edges of the incision being firmly approximated, there is less tendency for them to separate.
17. Drainage with a transverse incision is much more efficient.
18. Post-operative convalescence as a rule, in uncomplicated cases, is practically uninterrupted, because there is less shock at the time of operation and less post-operative pain.
19. Average length of time in bed is less.
20. Post-operative ventral hernia is very rare.

Disadvantages

As regards disadvantages, the only one of moment is the prolongation of the operation by perhaps two to five minutes; this, in the majority of cases, is negligible. It is questionable as to whether it does prolong the duration of the operation; because, while time is lost at one part, it is amply compensated for by the time saved in practically all other stages of the operation.

Mr. Maylard has personally informed me that he has seen a ventral hernia occur; but I have never seen one either in any of his cases or in any of my own.

The only adverse criticism of the transverse abdominal incision which has so far been noticed is in the *ANNALS OF SURGERY*, part 391, p. 632, where Doctor Meyer states that with this incision the layers of the abdominal wall do not come into as firm an apposition as they should, and that he was not using it as much as he did some years ago; from under the muscles one had for a time secretion. One hesitates to criticize the technic of a man of Doctor Meyer's standing, but I must say that I have never had any trouble, nor seen any trouble occur in any case, where approximation of the wound margins had been accurately obtained. In one or two such cases where such trouble did occur, it was found upon investigation that two or three of the deep sheath sutures had given, and a small amount of oozing had taken place. It might also be mentioned that Doctor Meyer was dealing with a case of gastric carcinoma, and it is well known how slow and imperfect these cases are in their healing; due most probably to the imperfect nutrition of the tissues forming the abdominal wall. It is not doubted that many individual surgeons

have their own individual objections to it; but its superiority over the longitudinal incision is unquestionable, because it is anatomically and physiologically correct.

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ACUTE INTESTINAL OBSTRUCTION

ENTERECTOMY, PARTIAL EXCISION, INCLUSION, POST APPENDICAL INCIDENCE, TREATMENT OF STUMPS

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THIS essay has been indited with the intention of inviting surgeons to take stock of present methods of dealing with the most grave acute problem in general surgery, and if any of the suggestions herein contained should prove of any value in helping to diminish the incidence of acute obstruction of the bowels, or in enhancing the chances of surgical relief, the time and thought devoted to its composition will be more than recompensed.

Adopting the motto "Avoid the abstract and stick to the practical," I commence by posing the question, what is to be done in case of acute obstruction, when a portion of the gut is found gangrenous? Before responding, one has to bear in mind that, from the moment the circulation of the bowel becomes impeded, splanchnic shock and systemic poisoning begin, and both intensify in compound ratio to the hours which pass until the obstruction is relieved. General symptoms often prove delusive guides as to the existence of this lethal combination, which seems temporarily to possess an insidious potentiality only requiring some slight surgical stimulation to unveil its effect with appalling rapidity, and whenever gangrene of intestine is met with, not only is it proof positive that the case has, for one cause or another, been sadly neglected, but there exist initial factors, poison and shock, which seriously handicap any attempt at human succor. And while primary knowledge of these unpropitious facts may tend, in a way, to alleviate the sense of dire responsibility which everyone feels when he finds himself confronted with this tragic affection, yet it in no way deflects from the duty to spurn finesse and, even at the risk of the dead stymie, ileus complete, to give every patient outside articulo mortis a surgical chance, remembering that conscientious work accomplished in the shortest time is the one thing most likely to snatch a victory, the master stroke being elimination of the morbid trio, eventration, undue manipulation and prolonged anæsthesia.

With this preface I will endeavor to give a reply to the above question: Concentrate attention on the extent of the gangrene, carefully scrutinize the condition of the mesenteric zone, confine the attack to what is essential, and, as every moment counts, "force the game."

I do not hesitate to state that, next to having details of likely operations in clear mental perspective, there is nothing more conducive to operative celerity than, while the patient is being prepared (always including gastric lavage) personally to superintend the selection of instruments and drains, the threading of an adequate assortment of needles, the provision of an ample

counted supply of sponges, towels, and some rubber tissue, not omitting a few sterilized kidney basins, and the apparatus ready for any washing or injection which may be required, warming up the operating table, and last, and indeed not least, securing the help of two smart assistants.

There is also a contingency which may seriously interfere with expeditious surgery in acute intestinal obstruction—assuming previous examination fails to give an indication—a very perplexing question arises at the start: where to make the incision so as to get directly at the seat of mischief? I cannot conceive anything more demoralizing to a surgeon than, when entering the abdomen on a forlorn mission, to find his energy and time sapped, at the outset, in struggling to restrain inflated intestine from bursting out through the parietal wound, and if the site of lesion is not evident, and, as frequently happens, the distention is so great and the serous coat of bowels so friable that it is impossible to pass the gut methodically through the fingers in search for the constriction without causing numerous peritoneal lacerations. His position is truly pathetic, between the scylla of traumatism plus exposure and the charybdis of retreating without having reached the objective, both possessing one, and the same, mortal denominator, “Yet is their strength labor in vain.”

These remarks are not penned on hearsay but on dire personal experience which incited me to publish a note in the *British Medical Journal*, November, 1918, on “the necessity to institute careful inquiry in every case of intestinal obstruction as to a previous attack of appendicitis,” or to an abdominal operation in which the appendix might have been removed for convenience, and “that regardless of the time which may have elapsed—detail revision of the patient failing to point the path—a four-inch incision should be made in the right semilunar line low enough to expose the ileocæcal region and right pelvis where the distal ileum will usually be found implicated in adhesions,” and while my experience may be exceptional, it suggests the personal conclusion that, excluding the era of iodine skin disinfection, and those which can be located before operation, in the majority of cases the obstruction of the small intestine will be encountered adjacent to the right pelvic brim, and that “the stereotyped central incision in such instances courts disaster, as in the search for the lesion the distended semi-paralyzed intestines are subjected to needless exposure and manipulation.”

It is not pertinent to the context to analyze the psychology which inspires postponement of operation in acute appendicitis until what is academically styled “the cold stage” supervenes further than to interpolate that patients so treated who escape immediate translation to the glacial state remain endowed with a nest of adhesions which renders them likely candidates for premature mortification by the peristaltic contortions of their own small gut. And in parembolism I must add that I am unable to comprehend the mentation which complacently admits of “we’ll wait until tomorrow to decide” in a case of suspected acute intestinal obstruction.

Acute Obstruction of Small Intestine.—In a number of instances in which

stoppage is suddenly caused by a band or kink only a narrow ring or small knuckle of bowel is found gangrenous, and in quite a proportion of these necrosis does not extend to the fixed portion of the gut, much less to the mesentery, the fact of the circulation in the heart of the intestine remaining intact induces a hope that there might be prompt restoration of peristalsis in the tube if inclusion or excision of the moribund area could be effected without entailing subsequent obstruction by diaphragm or angulation. Acting on this hypothesis, I venture to submit a classification from the operative angle, and I trust the suggestion will be viewed merely as a humble attempt to find some means of reducing the terrible mortality—40 per cent.—which attends surgical intervention as expressed in mediate or immediate enterectomy.

“A.” In cases in which one finds that a complete circle of the bowel is beyond redemption, I recommend that lateral anastomosis and excision of the gangrenous gut be carried out in the following order of detail :

(1) The affected zone of intestine is drawn out through external wound, extruding a sufficiency, above and below, so as to facilitate the performance of lateral anastomosis at a convenient distance from the lesion.

(2) The protruded bowel is fixed *in situ* by sponges which are meticulously packed into wound so as to preclude any possible regurgitation into the peritoneal cavity during subsequent manœuvres.

(3) Coils of proximal and distal healthy bowel are approximated and held in apposition by an assistant while four Triollet catgut Lembert sutures, half an inch apart, baste the apposed loops together, each stay is tied when inserted and its free ends caught in a pressure forceps.

(4) An opening, by sharp scalpel, two inches in length, is then made, close to and parallel with line of stays, into the distal gut—as no clamps are employed a kidney basin is made to catch whatever escapes—and then a pressure forceps is applied about the centre of free edge of incision to act subsequently as a tractor.

With a large kidney basin in position, a corresponding incision is at once made into the proximal bowel, free vent is afforded for escape of contents (the more the better omen) and the centre of free edge of this wound is similarly seized with a forceps.

(5) Two assistants then make gentle opposing traction on adjoining stays, while a continuous through-and-through Triollet catgut suture (tautly secured to each stay in transit) seals the posterior segment, the ends of the “central” stays are then cut short.

The forceps previously attached to the free edges of wounds are now grasped by an assistant so as to indicate a strategic site for the insertion of two anterior “central” stays, the continuous catgut through-and-through suture is then carried on (as it approaches each stay the latter is tied and continuous suture knotted to it) until closure of the anterior segment is completed, the ends of stays are then snipped away, and the whole field is washed

with warm peroxide lotion, dried with bibules, and the anastomosed part is enveloped in a dry towel.

(6) The gangrenous portion is then taken in hand, a catgut ligature is applied at least two inches, respectively, above and below the proximal and distal suspect limits, the intervening necrosed intestine is excised, any bleeding point in mesentery is immediately dealt with. A purse-string catgut Lembert suture is next inserted around the base of each intestinal stump, with a few snips of a scissors each stump is then freed from its mesentery just enough to render it easy for an assistant to invert it, with a dissecting forceps, into its corresponding lumen as the purse-string is being tied.

(7) A jug of warm peroxide lotion (1 in 35) is again requisitioned, a general wash and brush up follows, everything is thoroughly dried, and bowel returned.

Four or five through-and-through strong silk sutures close the parietal wound, leaving room at one angle for passage of two thick silkworm gut wisps which are so placed as not to adhere to any line of intestinal suture.

"B." In some cases an incomplete narrow ring of gangrene results from constriction by band which in width more or less corresponds to that of the band itself; if this does not exceed one centimetre and the mesenteric zone is healthy, the affected coil is drawn out through wound and secured in place as before mentioned. Four equidistant long catgut Lembert stay sutures are then passed—skipping over the dead zone—through living proximal and distal gut; these sutures are not for the moment tied, their ends are respectively caught in forceps, the assistants with blunt hooks retract the loops of these stays well out of the way, while a kidney basin is placed in position and a transverse incision made through the whole extent of the gangrenous area (N. B., this incision is only made in cases where, after removal of the "external" obstruction, there is no consequent visible inflation of the distal bowel), thus free escape for contents is provided, when the flow ceases, the hooks are removed from loops, the forceps grasped and upper and lower intestine approximated, the stays are then tied and a forceps applied to each pair of free ends with which the assistants make opposing traction, while a continuous catgut Lembert suture, braced to each stay as it passes, completes the matter, the ends of stays being clipped away, the toilet, etc., is effected as in "A".

"C." The most difficult case for decision is the one in which a band, kink or twist has caused more extensive necrosis, the fixed portion of gut remaining suspect, and mesentery apparently uninvolved, the problem then arises, can infolding or excision of gangrenous section be accomplished without leaving an obstructive diaphragm or angulation? In order to clear perspective I wish here to mention that I cannot, as yet, recommend the adoption of either, if the belt of gangrene exceeds a width of one inch, anything above that commands the major procedure "A", but within this limit the complications mentioned can be obviated.

Three long catgut Lembert stays are inserted, as in above, into proximal and distal bowel, one along free border and one on each side midway between this anterior stay and mesenteric attachment, blunt hooks are then made to pick up loops and retain them clear of the field while a free crucial incision is made through the moribund segment, when the intestinal discharge has ceased, the loops of stays being still held aside, the four gangrenous flaps (made by crucial incision) are liberally excised with scissors, the stays are then drawn taut so as to facilitate inspection of the amount of angulation produced by approximation of the proximal and distal gut, two similar lateral stays are next inserted close to mesenteric line embracing as much or as little of the peritoneal coat, above and below, as may be judged necessary to correct any likely kinking by the anterior sutures, the five stays are then tied and a continuous catgut Lembert suture applied as in "B".

The part stays take in the above procedures possibly warrants a little amplification. They, from beginning to end, make for rapidity and good workmanship in that they point the line for the continuous suture, help to secure its tension, and in themselves, form a strong second line of defence. They are infinitely preferable to clamps, as they do not cause any devitalization of tissue, which by the way, in acute intestinal obstruction is already sorely attenuated by distention and toxic infiltration. They possess a sound surgical attribute, viz., they admit of seeing a bleeding vessel and tying it. They serve as excellent pliable tractors by which the operator can dominate at will the slippery, sloppy ground on which he has got to work, and consequently are the best insurance against an attack of "the tail wagging the dog," at a moment when one carries a heavy time handicap in a race for life in the most fatal of acute surgical affections.

Acute Colic Obstruction.—In this catastrophe, if the problem as to the seat of lesion is not solved before operation, it may be taken for granted that what was mentioned as a contingent complication in acute "intestinal" is a certain one in advanced colic obstruction, and, owing to the enormous distention associated with the latter surgical intervention, as often as not ends in a tragedy. After a certain amount of prolonged pressure and manipulation necessary to retain intestinal balloons inside the abdomen, a rather sudden and unexpected relaxation of tension occurs which is apt to lure one on to proceed instead of beating a rapid retreat, but which in reality is the culminating exposition of intestinal paralysis induced by the superaddition of traumatic to preëxisting splanchnic shock. The curtain then drops as the anæsthetist whispers the epilogue—myocardial liquidation has begun.

Under such circumstances it is natural that one should seek for some mode of escape before the advent of the fatal loss of spring, and I cannot see anything promising on the horizon except in all cases in which through examination and careful study of the history fail to give a clue to the whereabouts of the obstruction, to make a right semilunar incision, explore gently for a few minutes, and if there is no result, proceed at once with the preliminary step of closing the wound by inserting four or five long through-and-through

strong silk sutures, and without knotting catch the ends of each in a pressure forceps. Then coax the left hand supinated and extended, between parietal peritoneum and bowels, over to the right iliac fossa, where two fingers flexed forward point the site for an incision large enough to allow the external inferior sacculum of the cæcum to be drawn outside and maintained there momentarily by forceps. The semilunar wound is then rapidly closed, and a dressing applied, covered by rubber tissue and a towel, and immobilized by fixation forceps.

Attention is then turned to suturing exposed cæcal sac to margin of iliac wound in such a manner as to preclude any subsequent backward percolation. The patient is then gently rolled over on his right side to the edge of the table, a basin is placed in position, and a stab made into gut sufficiently large to give free vent to its contents.

I have had gratifying results with this method, and whenever feasible, I like to employ the external inferior sacculum for drainage, as its site is strategic, it seems anatomically adapted for the purpose, it occasionally closes spontaneously after the obstruction disappears, and can be closed by operation without encroaching unduly on the lumen of cæcum.

The early insertion of the through-and-through silk closure sutures may require some explanation. These sutures, in place, help to prevent a rush from within as the wound can be promptly occluded by traction on their forceps and thus diminish pernicious handling of bowels. They afford good support for any temporary packing, their presence tends to obviate separation of layers of parietal wall during operation. Owing to internal pressure their introduction may be an arduous business which had better be effected, so as to save valuable time, before the fatigue stage supervenes; and the fact of their being in, affords a comfortable homeward-bound feeling, which, on occasion, is not to be despised. If long threads of silk are used the loops can be readily hooked away from field so as not to cause any operative inconvenience.

It may have been observed that I advocate an incision in the right semilunar line for both acute colic and acute "intestinal" (unplaced) obstruction, the reason for doing so being that if one reflects on the statistics of acute abdominal lesions of which 70 per cent. are credited to appendicitis, if to this be added the incidence of pyloric duodenal and biliary affections, the ratio of involvement of the right as compared to the left abdomen must certainly stand not less than eight to one, and, knowing that the most frequent cause of obstruction is the legacy peritoneal agglutination following infective processes and operations for their relief, the deduction is, to say the least, logical that, given no direct guide, the chances are greatly in favor of finding the lesion in the right abdomen. And as to the systematic search for obstruction by passing the gut through one's fingers, my experience dictates that this can be (when serous coat permits) as effectively done through a right semilunar as through any other incision.

As to making a separate suitable opening in right iliac fossa for cæcal drainage, I am all in favor of it, for it appreciably diminishes the risk of subsequent virulent infection, and its consequences, in the large primary wound.

Peritoneal Seclusion of Stumps.—In 1903 I received my first object lesson as to the danger of leaving raw endothelial stumps in the peritoneal cavity, in the case of a well-known young lady on whom I performed double oöphorectomy for cystic disease, and as the appendix was very much in evidence I thought it expedient to remove it. This was done by a method in vogue at that period, viz., ligation and touching the stump with a disinfectant. As there were no adhesions, the whole operation was simplicity itself. Ten days later, she suddenly developed acute intestinal obstruction; the wound, under anæsthesia, was opened up, and to my intense disgust, I found the stump of the appendix glued to that of right ovary with a coil of congested ileum clutched in the adhesion. An uneventful convalescence ensued. Since then appendical stumps have, when possible, been buried in the cæcal wall or covered with an omental plaster.

The most recent reminder occurred in a married lady on whom I performed right oöphorectomy in October, 1920. As customary the appendix, for insurance reasons, was also removed and stump interred. On June 3, 1921, she was suddenly seized with violent abdominal pain and vomiting, which her doctor attributed to "acute gastritis"; various enemas and purgatives were ineffectually administered during the following four days. She was brought into hospital on the fifth morning, the abdomen was distended, stercoraceous vomiting incessant, no general symptoms beyond a distressed facial expression. A test enema was at once given, without result; as soon as the stomach was delivered of a basinful of dark green foul liquid she was transferred to the operating table. As parietal, vaginal and rectal examinations gave no indication, I made the usual right semilunar incision, immediately some coils of distended congested ileum bobbed up in the wound which were returned by bibule pressure, and the left hand was then introduced into right pelvis where it found a loop of ileum bound down, after the manner of a Christmas cracker, by a tense band about one centimetre in breadth and ten in length, passing from below cæcum to base of right broad ligament, the left index finger was gently insinuated beneath band and strictured gut and former elevated (without rupture) for inspection, then we found the silk ligature which had been placed nine months previously on meso-appendix, snugly encircling the band about half an inch from its upper point of fixation, affording a direct and positive proof that the band had originated in and included the stump of the meso-appendix. A small cæcal scar indicated the tomb of the appendix, and the right ovarian stump was free and had contracted to the size of a pea. The band was excised and gut drawn up into wound, a belt of gangrene, corresponding to width of band, involved the greater part of free zone of bowel. Stays were inserted, and as peristalsis had

visibly resumed its function, the necrotic segment was infolded (without incision) by stays and a continuous Lembert catgut suture. Prompt recovery followed.

Some months previous to this, while pondering over the matter of how to reduce contact to a minimum when dealing with the stump of an infected appendix, I stumbled into a very simple method of secluding the stump of the appendix and that of meso-appendix by one ligature in one peritoneal pocket, and, "en passant," I may add that my colleague, Doctor Fehilly, and I have employed it in many cases and find it as useful as it is practicable.

(1) The meso-appendix is ligated and appendix isolated in the usual manner; the ends of ligature are not cut away.

(2) A curved intestinal needle is then attached to one end of this ligature and a three-insertion (two lateral and one anterior), purse-string suture is passed, at a distance of about one-third of an inch, around the base of the appendix; the anterior point of suture is purposely inserted beneath the anterior longitudinal band.

(3) The needle is then removed and the ends as well as the loops of the purse-string are left loose and kept out of the way while the appendix is clamped at level of cæcum separately ligated, and cut away.

(4) The ends of the "ligature suture" are then sought for, and as they are tied together (the assistant with a dissecting forceps pushing the appendical stump backwards) both stumps instantly and definitely disappear from view—only two things touch the raw surface of the stump of appendix—the knife and the dissecting forceps.

The above is the first instance in which I found the stump of the meso-appendix *in flagrante delicto*, but I have often suspected its complicity in pelvic adhesion jungles; however, knowing the tendency that peritoneum has to adhere to any raw surface, I think I may safely advocate burial of this stump, particularly as both it and its mate (of the appendix) can be readily interred together with the same bit of string.

Peritonization of Stump After Salpingo-oöphorectomy.—After periodic attempts at rotating the ovarian or salpingo-ovarian stump downward and suturing it face backward on the anterior shelf of its broad ligament, I have definitely abandoned the procedure as I found it, almost impossible to avoid, even with blunt instruments, the occasional formation of a troublesome intra-ligamentous hæmatoma, and moreover, the manipulation necessary for such adjustment endangered the security of the pedicle ligature.

Instead, I have adopted a much more simple and more readily applicable method which can be always resorted to without "asking for trouble," viz., a web, about one or two inches square, is excised from the omentum and plastered over the surface of stump, and a piece of fine silk (or the ends of the ligature) is made to secure it, in bonnet fashion, around the neck of same. In infected cases I always employ catgut instead of silk for ligation of pedicle and for fixation of this omental "patch."

RECTAL AND VESICAL INCONTINENCE RELIEVED BY OPERATION

By JOHN G. SHELDON, M.D.

AND

EDWARD P. HELLER, M.D.

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M. K., male, age twelve years, was brought to the Vineyard Park Hospital in June, 1921, for relief of incontinence of urine, with a history that he had never had any control of his bladder, and had always had to wear a diaper. At night, and when recumbent, drainage is less. He was born with an imperforate anus. (Figure 1.) When 24 hours old the attending physician inserted a knife into the anal region, and succeeded in entering the pouch of the rectum. He sutured the cut edges of the rectal pouch to the skin (mother's statement). These sutures did not hold, and a second operation was performed three days later.

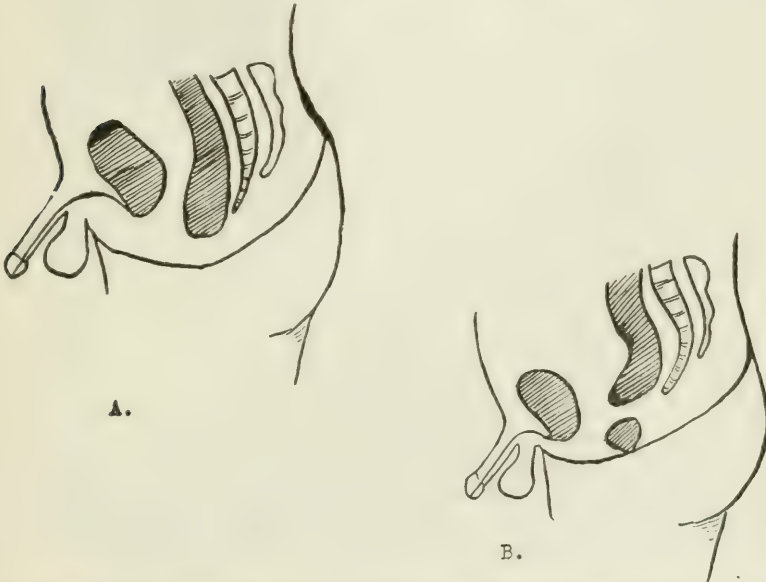


FIG. 1.—(Stewart.) A. Imperforate anus,—the original condition in the case herewith reported.
B. Imperforate rectum. In the present instance there was no evidence of an anal pouch.

This operation was successful as far as establishing an anus was concerned, but there was no control of the bowels. At the age of three, he was taken by his parents to a surgeon in the Northwest, who performed a muscle-flap operation (mother's statement). Two weeks later the flaps had to be cut as no bowel movements were possible. The child's condition was now as before operation. Nothing was done, however, until two years later, when he was taken to a large clinic in the Middle West, where a "puckering-string operation was done" (mother's statement). At this time, an attempt was made to correct the enuresis by passing a catheter at regular intervals. Two weeks after return to his home, he was in the same condition as before operation. He remained in this state of incontinence of urine and feces until November, 1919, when he came under our

observation. When admitted he had an incontinent anus with no sphincter that could be discovered. There were scars about the anus, the result of previous operative procedures. It was decided at this time to attempt to provide a rectal sphincter from flaps of the glutei maximi. Since four weeks after operation, (a space of 18 months), he has had perfect control of his bowels. No attempt was made to correct the enuresis, and it is for this condition that the child has been brought back for treatment.

Family History: Negative. There are three younger children in the family, all of whom are physically perfect.

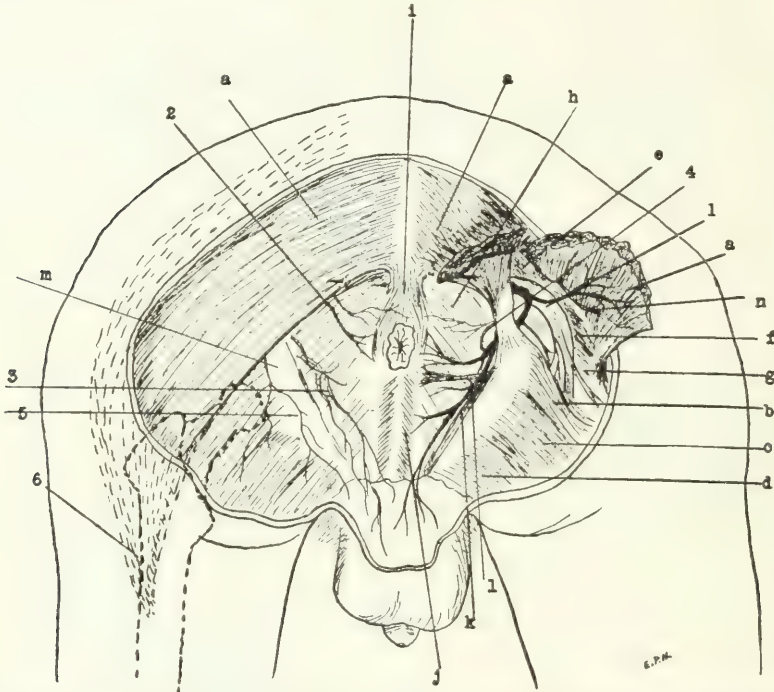


FIG. 3.—(Treves, after Rüdinger). The male perineum. a, gluteus maximus; b, semi-tendinosus and biceps; c, adductor magnus; d, gracilis; e, pyriformis; f, obturator internus; g, quadratus femoris; h, levator ani; i, external sphincter; j, bulbo-cavernosus; k, ischio-cavernosus; l, transversus perinei; m, tuber ischii; n, inferior gluteal nerve (branches). 1, sciatic nerve; 2, inferior hemorrhoidal vessels and nerve; 3, superficial perineal vessels and nerves; 4, pudic (internal pudendal) nerve (cut) and pudic artery; 5, perineal branch of posterior cutaneous of thigh; 6, semi-diagrammatic representation of attachment of gluteus maximus (a modification added by one of us).

Physical Examination: A well nourished boy, surgically negative except for scars over both gluteal regions, (Figure 2), and obliteration of the gluteal folds, the result of the previous operation in which a muscle-bundle from each gluteus maximus was swung around the rectum. There is no control of micturition, and a diaper is worn constantly. The urine drainage is worse when he is up and about—the urine dribbling from the urethra at a slow steady rate. On assuming the recumbent position the flow is somewhat less.

Description of First Operation.—Formation of rectal sphincter. (November, 1919.) With the patient in the reversed Trendelenburg position, long incisions were made in line with the fibres of the gluteus maximus muscle on either side, and extending approximately three inches above and three inches below the tuberosity of the ischium on each side. (Figure 2.) Having isolated the mesial fibres of the gluteus maximus on one side, a search was begun for branches of the in-



FIG. 2.— (Photograph taken 18 months after operation). a. Upper end of incisions; b. lower ends of incisions; c. position of ischial tuberosities. The patient has purposely been placed in the same position as when operated upon. It will be noted that the gluteal folds have been obliterated because of the underlying muscle bundles. Note the deep perineal crease.

RECTAL AND VESICAL INCONTINENCE RELIEVED

ferior gluteal nerve. (The inferior gluteal nerve arises from the posterior divisions of the 5th lumbar and the 1st and 2nd sacral nerves; it leaves the pelvis through the great sacro-sciatic foramen, below the piriformis, and divides into branches which enter the deep surface of the gluteus maximus muscle.) For success it is necessary that a good innervation be secured for the flap. (Figure 3.)

Having isolated a bundle of muscle fibres about 2 inches in breadth, with the necessary nerve supply, the bundle was separated from the upper angle of the wound down to the femoral attachment. Here a strip of periosteum was removed

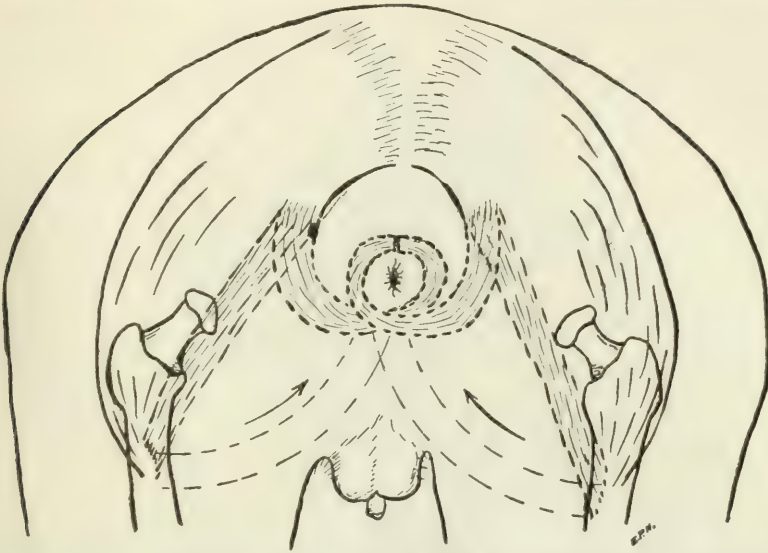


FIG. 4.—Diagrammatic representation of the method by which the sections from each gluteus maximus were detached and swung around the anus beneath the superficial structures of the perineum, and sutured together.

with the muscle in order to prevent fraying of the ends of the fibres, and to assure secure anchorage for the sutures which were to unite this muscle bundle with its fellow of the opposite side.

By the same procedure the other gluteus maximus was isolated and a similar muscle bundle, with a large branch of the inferior gluteal nerve, separated throughout the length of the incision, and including the periosteum of the femur below the great trochanter.

By blunt dissection a channel was tunnelled completely around the rectum—or better, around the anal canal. By retracting the undermined skin, and by sliding first one muscle flap and then the other around the rectum as shown in Figure 4, the ends of the flaps were brought into apposition, and sutured together with chromic catgut.

After hæmostasis, a rubber drain was inserted into each wound to care for the secretions of the first 24 hours, and the wounds closed with silkworm gut sutures. The patient was made comfortable by changing his position from one side to the other. Healing of the wounds was uneventful. At the end of the third week, there was some evidence of control of the bowels. At the time of dismissal—the end of the fourth week—there was control of the bowels during the day. One week after returning to his home in Idaho, the boy states that he discovered how to control his bowels, and that gradually this control became involuntary. Now his improvised sphincter remains contracted, or on guard, so to speak, at all

times except during the act of defecation. A point of interest is that the sphincter contracts independently of the remaining portions of the gluteus maximæ.

Description of Second Operation.—*Correction of vesical incontinence*, June 17, 1921.

In view of the previous history, the success of the first operation, and on the assumption that a fetal type of bladder was responsible for the persistent incontinence of urine, an operation was agreed upon for the relief of the enuresis.

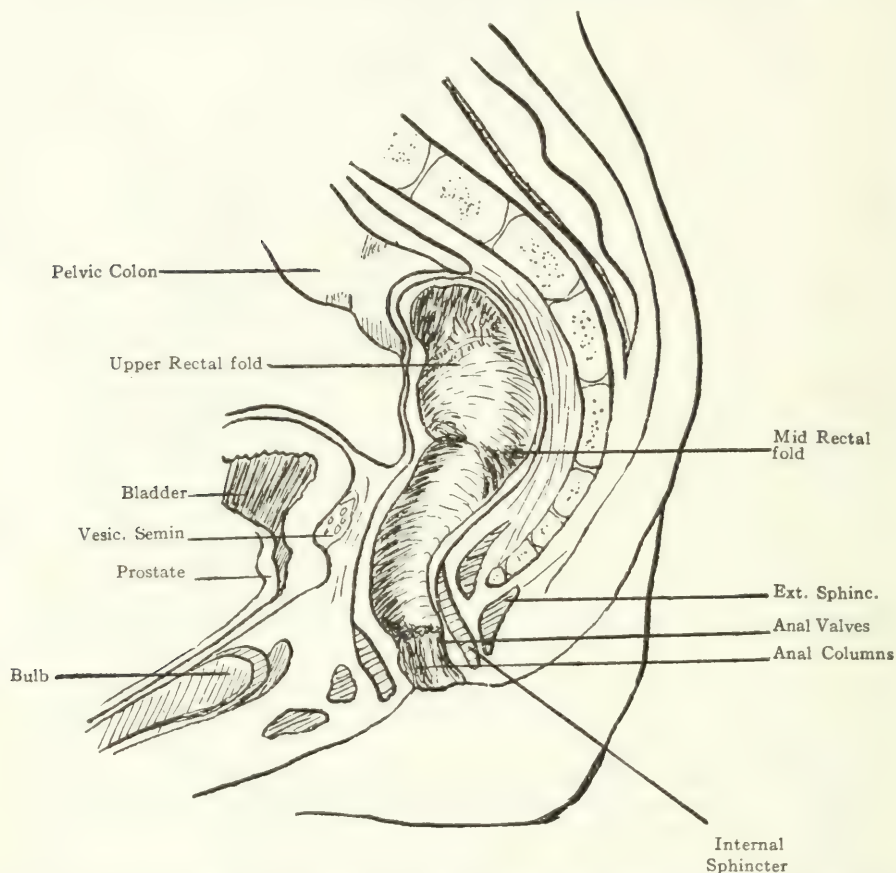


FIG. 5.—(Treves, after Prof. A. M. Paterson.) Diagram showing the stages of the rectum and the anal canal on mesial section. This figure is interposed to illustrate the normal arrangement of the structures about the anus and rectum. In the first operation reported herewith, it will be seen that the muscle flaps take the place of the internal sphincter, and to a large extent, of the external sphincter also.

A three inch suprapubic incision was made, and the structures carefully inspected layer by layer. Much to our satisfaction, our assumption proved to be correct, for on arriving at the peritoneum, the urachus was found to be patent up to within two inches of the umbilicus, and both hypogastric arteries were pervious and of good size. These three structures were divided and ligated properly on a level with the upper limit of the fundus of the bladder. The bladder was then pushed well down into its proper position in the pelvis. (See Figure 6.) A short rubber tube drain was inserted down to the prevesical space, and the wound closed with silkworm gut sutures.

In order not to leave undone a procedure which might aid in his recovery, a circumcision was performed.

RECTAL AND VESICAL INCONTINENCE RELIEVED

As far as the wounds were concerned, recovery was uneventful; the rubber drain was removed the day after operation, and the sutures were removed from the abdominal wound on the seventh day. He was up in a chair on the fifth day and was walking about on the ninth day.

As to his bladder condition, the following notes were taken from the Progress Record: First day post-operative, there was some discomfort at glans penis, and some burning on micturition—due probably to the circumcision. Second post-operative day, uneventful except for frequency of micturition—capacity 25 to 50 c.c. urine, with knowledge of start of act of micturition. Fifth post-

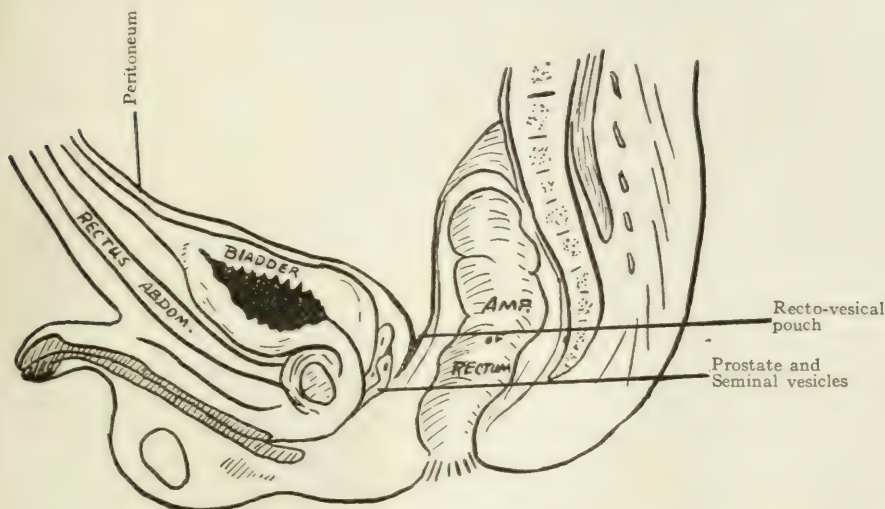


FIG. 6.—(Gray's Anatomy, after Corning.) Mesal section through pelvis of a new-born male. This diagram shows the position of the bladder as found at the time of operation (second operation herewith reported), with the exception that the cavity of the bladder extended further upward into the urachus. The urachus, or middle umbilical ligament is the impervious remains of the tubular canal of the allantois, which existed in the embryo, and a portion of which expanded to form the bladder: It passes upward from the apex of the bladder, between the transversalis fascia and the peritoneum, to the umbilicus, becoming thinner as it ascends. It is composed of fibrous tissue, mixed with plain muscle fibres.

operative day almost complete control of micturition, and increase in capacity of bladder to 300 c.c. Sixth post-operative day, no longer kept urinal over penis, but requested it at intervals. Control absolute. Still some frequency. No dribbling. Ninth post-operative day—no dribbling while walking about. In knee-chest position for 20 minutes while photographs of gluteal region were being taken and no dribbling occurred. Eleventh post-operative day was dismissed, and to date has had no recurrence of enuresis.

Comment.—It has been stated in the foregoing that the form and position of the bladder were believed to be the cause of the urinary incontinence. The diagnosis and the operative procedure were based on the Goltz theory of micturition. In 1874 Goltz¹ evolved the theory that micturition is due to the following causes: The presence of urine in the urethra resulting from distention of the bladder, contractions of the bladder, or positions of the bladder or patient, were responsible for the desire to micturate. While it is true that the work of Guyon and others apparently disproved the correctness of this theory, we have several clinical observations that support it in some cases. The formation of a rectal sphincter involved purely mechanical and anatomic considerations.

CONCLUSIONS

In view of the operative findings and result obtained in this case, we shall investigate with interest the position and shape of the bladder in all cases of urinary incontinence.

Regarding the rectal operation, this case, and an experience with two others of a similar nature, prompts us to record mistakes which were made in our first operations of this type: (1) The fibres of the gluteus maximus should not be severed, but should be detached with the periosteum at the site of insertion on the femur; (2) the muscle flap should be ample, at least an inch in diameter—even in children; (3) if possible, the nerve supply of the muscle flap should be investigated, and retained even if a large portion of the muscle must be incorporated in the flap.

REFERENCE

¹ Archiv für die gesammte Physiologie, 1874, Bd. viii, S. 478.

SECONDARY FOCI OF TUBERCULOSIS IN THE SPINE IN POTT'S DISEASE

BY CHARLES W. PEABODY, M.D.

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STUDY FROM THE ORTHOPÆDIC CLINIC OF THE MASSACHUSETTS GENERAL HOSPITAL

ABOUT six months ago on the Orthopædic Service of the Massachusetts General Hospital a patient had been scheduled by the writer for operation who was to have a bone graft for Pott's disease of the dorsal spine, an extensive process having destroyed the ninth and involved the eighth and tenth dorsal vertebræ. Just before the hour of operation during the weekly "ward rounds" on the service, the X-ray plates of this patient among others were demonstrated to the members of the staff. At this point, to the writer's chagrin, the Chief of Service, Dr. R. B. Osgood, called attention to a vertebral body lying at the lower edge of the exposed field. Its outlines were much obscured by the shadow of the cylinder of the Röntgen tube, but on close inspection it appeared to be distinctly wedge-shaped. Between it and the process above lay two normal bodies and intervertebral discs, and for this reason no attention had previously been directed to it. The significance of this finding in relation to the proper operative procedure was of course apparent, and the latter was postponed pending further X-ray study. Subsequent plates were confirmatory, showing a typical deformity of the second lumbar vertebra and the disappearance of the disc space below it. In other words a secondary focus was present in this spine. Unless this second focus had spontaneously healed during the post-operative recumbency, which is unlikely, as in this clinic this period is not a very extended one due to the internal fixation, its progress would have been aggravated by reason of the increased strain from the immobilization of the overlying spine, and the patient would have been as bad off with his lumbar Pott's as he had been with the dorsal. But while relief was felt at the timely discovery, it was generally felt too rare an occurrence to be seen again.

A few months later a patient presented himself for examination by the writer in the Out Patient Department who had had a bone graft for a mid-dorsal Pott's about eight months previous. He was wearing a light back brace but complained of the same pain and weakness in back as before operation and localized a point of tenderness a little lower down. X-rays were taken, and to our surprise the plates, showing the graft in place in the spines of the sixth to eleventh dorsal vertebræ, also showed a disappearance of the disc between the last dorsal and first lumbar and a deformity of the body of the latter. The process above centered in the ninth dorsal and involved the two adjacent bodies, leaving a normal segment between it and this lower one. Recalling the case first cited, we forthwith looked up the Röntgenologist's interpretation of the pre-operative plates of this second patient, with the

discovery that apparently this second lesion had been distinguishable even then, although the wording was a little misleading and gave the impression that the lesions were in continuity. After some search these original plates were also found, and, while the lower area was not clearly in focus, comparison of the two sets showed that a definite secondary lesion clinically unrecognized had existed prior to operation.

Within a few days after this incident the writer examined and sent into the ward for study a young Italian laborer with a large low abdominal mass, a contracted hip, and indefinite symptoms in back suggesting a low lumbar or pelvic tuberculosis. The initial X-ray examination revealed an early destructive process in the fifth lumbar vertebra. As this did not appear very far advanced it was thought by the staff insufficient to explain the large psoas abscess present, and further X-ray study of the spine was made. This revealed an advanced Pott's disease with encircling abscess shadow in the lower dorsal spine.

The findings initiated a discussion in the clinic of all three cases, which brought out the fact that a patient had recently been operated on by the fusion method for a tubercular process developing some time after a previous bone graft, but at a slightly lower level than the first.

Thus within a space of less than six months four cases of distinct secondary foci in the spine had come under observation in one clinic; yet the prevailing opinion therein was that such a condition was exceedingly rare. Two questions presented: Were we working under a considerable misapprehension regarding the incidence of an important complication of Pott's disease; or have the usual methods of examination been too limited to reveal this phase? The first question seemed easy to answer, and the Index Medicus was turned to; but in the titles for the last ten years no mention of this matter of secondary foci was found. Did this indicate that it was a condition too rare to be of importance, or too common to merit emphasis? With the latter possibility in mind the standard text books on Orthopædic Surgery were consulted. Out of five examined only one made reference to secondary foci in the spine, that of Whitman mentioning a series of 1356 cases in which sixteen, or less than eight-tenths of one per cent. showed lesions in two regions. But these findings were obtained from tracings made of the spine and not as a result of X-ray examination. Still convinced that the problem could not be so rare as apparently indicated by the scarcity of reference in the literature, it was determined to seek information from the fairly considerable number of cases of spinal tuberculosis on record in this hospital. Diagnosis files were found to contribute nothing in this regard. Dispensary record notes contained little detailed information and were equally unproductive. On the other hand scrutiny of a portion of the mass of ward patient records proved so time consuming that some short-cut was sought. It seemed apparent that in the last analysis the only confirmative evidence of absolute value would arise from the X-ray data on a case, and hence the most productive endeavor would be in the records of this department, which was inclusive of both O. P. D. and ward

TUBERCULOSIS IN THE SPINE IN POTT'S DISEASE

cases. The diagnoses in all examinations made since 1913 were found still on file. Those finally and definitely diagnosed as "Pott's Disease" or "Tuberculosis of the Spine" were segregated, amounting to 315 patients (the total number of examinations made on these patients being of course several times greater, appearing in succeeding years). The original descriptive cards of these examinations were then consulted for a detailed interpretation of the X-ray picture. For the first six-year period these were found disappointing in value, in that a detailed report was lacking, and a summary only appeared, such as "Old Pott's Spine" or as "Tuberculosis of Dorsal Spine." However

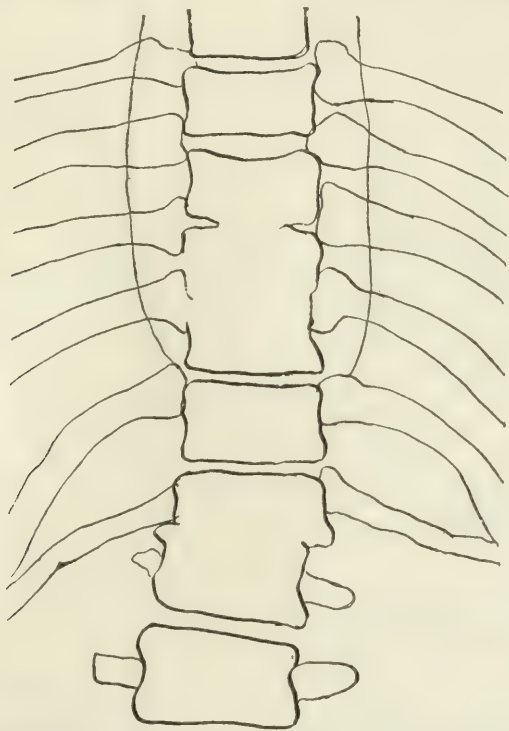


FIG. 1.—Case VII.—Jos. W. A-P view of dorso-lumbar juncture showing typical lesion in lower dorsal spine and also one in upper lumbar area.

in this group several instances occurred in which even in the abstracted form note was made of two foci being present. From late 1918 to date the records contained the complete dictation of the röntgenologist; and in this latter period were found five cases in addition to the four described at the beginning of the paper with a definite observation of secondary foci. The reported findings of the thirteen patients follow. Each report concluded with the diagnosis of tuberculosis.

Group I. Two hundred cases, four with secondary foci, or two per cent.

Case I. Stephen T., No. 2193. "A pathological process involving first and second lumbar and also one involving the fourth and fifth lumbar."

Case II. Mario L., No. 41376. "A destructive process involving twelfth dorsal and first lumbar and intervertebral disc, also third and fourth lumbar and disc."

Case III. Morris R., No. 37866. "The seventh dorsal is partly destroyed; there is also a destructive process involving ninth and tenth dorsal."

Case IV. Carline V., No. 41826. "Rather extensive destruction of body of the fifth dorsal vertebra; process seems confined to the body; the seventh is distinctly wedge-shaped, diagnosis deferred." A year

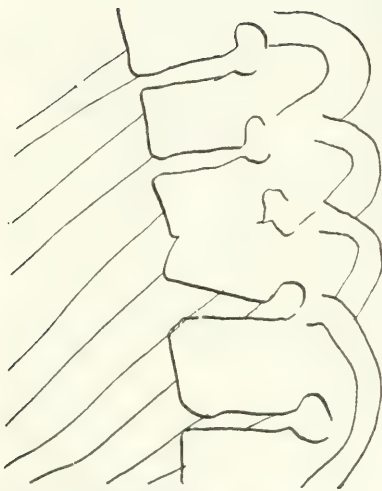


FIG. 2.—Case VII.—Small plate focussed over lower dorsal and showing appearance of lesion here in lateral view.

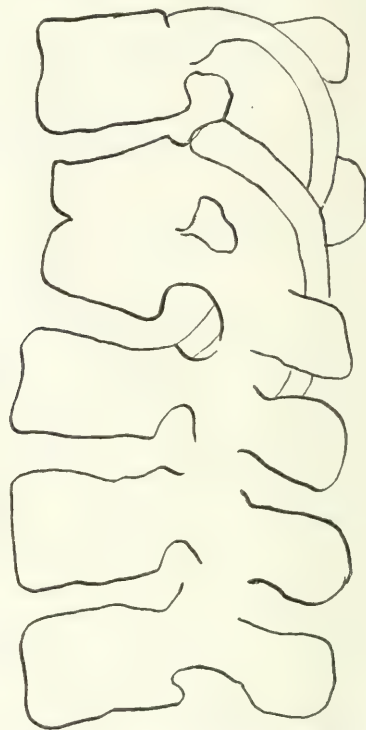


FIG. 3.—Case VII.—Lateral view of lesion in upper lumbar spine.

later examination showed abscess shadow and definite diagnosis of tuberculosis was made.

Group II. One hundred and twelve cases, nine with secondary foci, or eight and two-tenths per cent.

Case V. Lorenzo B., No. 64014. "There is a destructive process involving eighth and ninth dorsal vertebrae and disc; also a process in first and twelfth", and first lumbar.

Case VI. Amelia D., No. 57041. "The tenth and eleventh dorsal are fused; the first lumbar and disc below are also affected."

Case VII. Joseph W., No. 37537. "The ninth and tenth dorsal vertebrae are partly destroyed; there is also a process between the first and second lumbar."

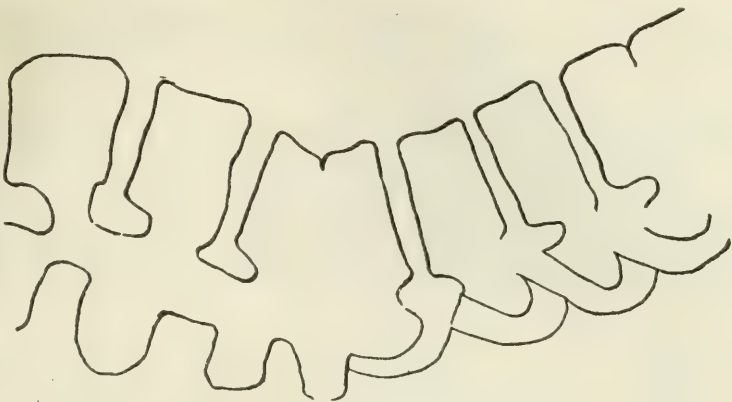


FIG. 4.—Case X.—Ephthia S. Lateral view of lumbar spine showing fusion of second and third vertebrae. A horizontal line is a normal segment and at the top the plate evidence of the pathology in the dorsal spine can be made out.

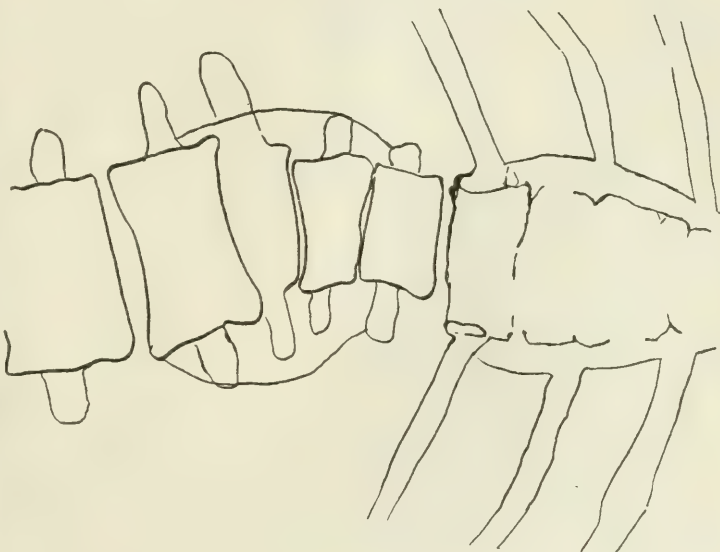


FIG. 5.—Case X.—A-P view including both lesions. A dense abscess shadow overlies the dorsal one.

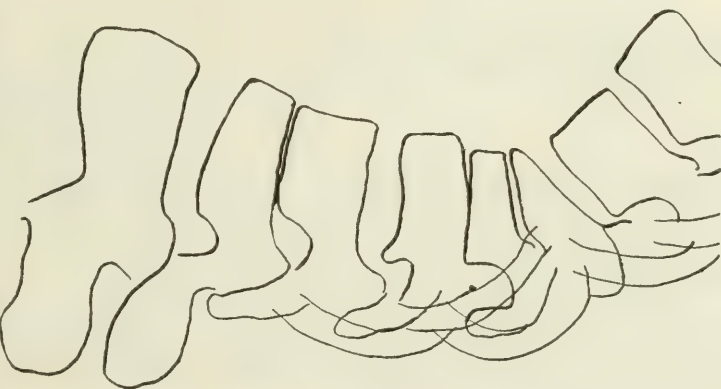


FIG. 6.—Case XI.—Michael S. Lateral view of dorsal spine, with a destructive process shown and a normal subjacent area.

Case VIII. Grace T., No. 49324. "There is a destructive process involving the first and second lumbar. There is a second process involving the tenth and eleventh dorsal."

Case IX. James H., No. 54518. "A destructive process involving seventh and eighth dorsal with disappearance of intervening space. The tenth and eleventh are also affected and the space narrowed."

Case X. Ephthis S., No. 64418. "An extensive destructive process involving ninth, tenth and eleventh dorsal vertebrae, with an abscess shadow present." At a later date: "plates confirm above and show second lumbar to be wedge-shaped and disc below destroyed."

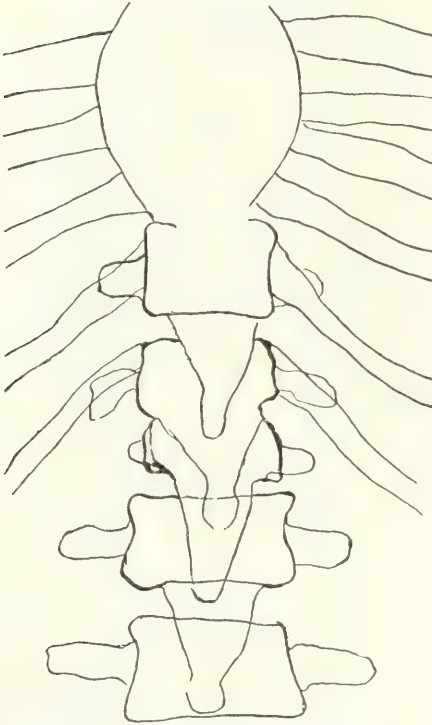


FIG. 7.—Case XI.—Dorso-lumbar area in A-P view showing evidence of an additional focus in lumbar spine.

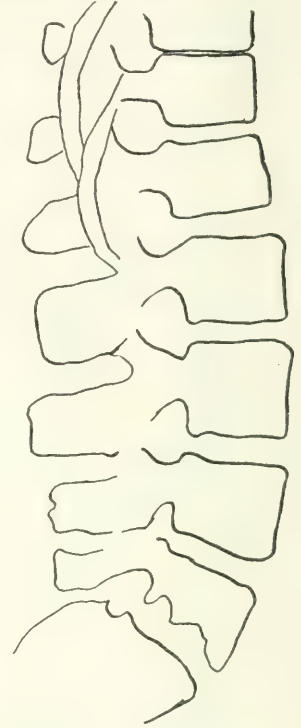


FIG. 8.—Case XII.—Sebastiano C. Lateral of lower spine, the fifth lumbar being seen definitely diseased, and at the top of the plate the disappearance of the disc between the eleventh and twelfth dorsal indicates another process in this region.

Case XI. Michael S., No. 63955. "Extensive destructive process involving ninth, tenth and eleventh dorsal. The twelfth is normal. Bone graft can be made out in sixth to eleventh. There is an additional process between the first and second lumbar."

Case XII. Salvatore C., No. 72831. "Plates show destructive process in body of the fifth lumbar. Additional plates show involvement of the ninth, tenth and eleventh dorsal vertebrae with surrounding abscess shadow."

Case XIII. Mary C., No. 57877. "Tuberculous process involving

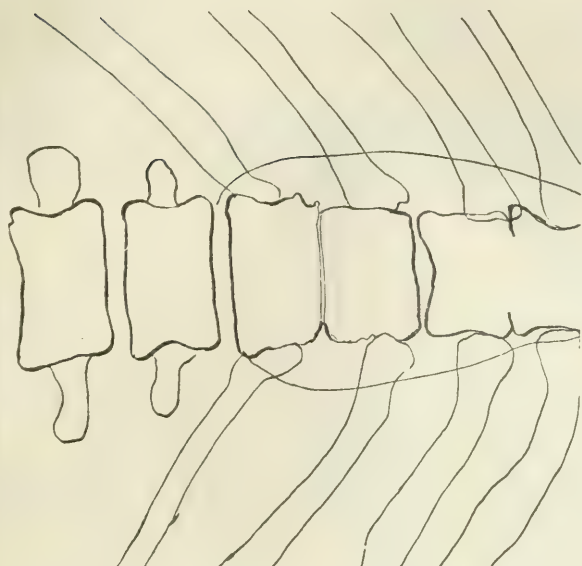


FIG. 9.—Case XII.—Process in lower dorsal seen in A-P view, abscess shadow present.

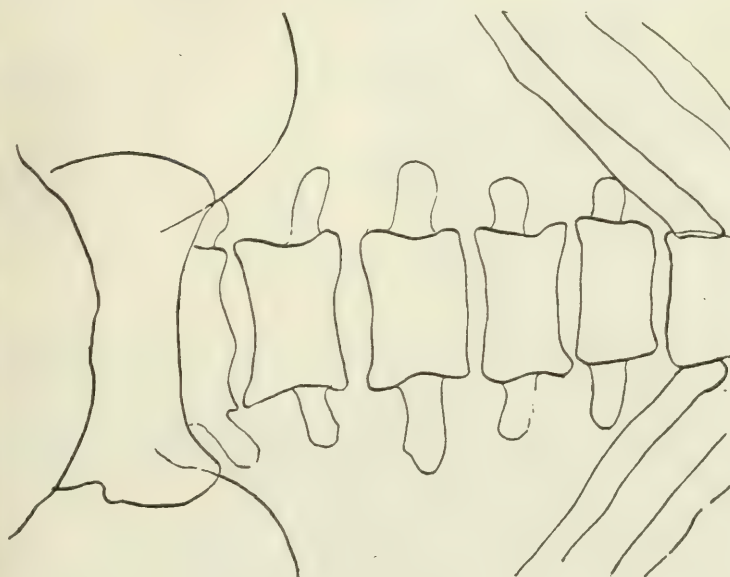


FIG. 10.—Case XII.—A-P view of deformity in fifth lumbar.

ninth, tenth and eleventh dorsal vertebræ with bone graft in place. There is a process below the graft involving the twelfth and first lumbar."

Total of groups I and II equal 312 cases with thirteen secondary foci found, or four and one-tenth per cent. for the whole number.

NOTE:—The illustrations are limited to those cases which have been personally observed by the writer, i. e. the four mentioned in the introduction, listed as cases ten to thirteen inclusive, and also case seven, whose two spinal foci were simultaneously recognized and appropriately treated several years ago, but who is still under treatment for a subsequently developing tuberculous hip. The X-ray negatives of all these patients were

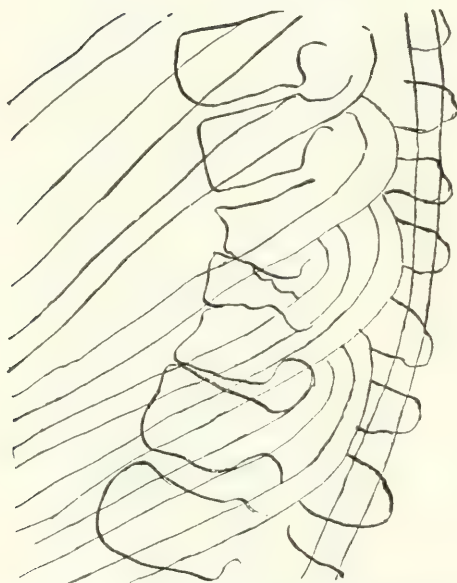


FIG. 11.—Case XIII.—Primary focus in dorsal spine seen from side. The shadow of the bone graft in this case could be seen along the spinous processes.

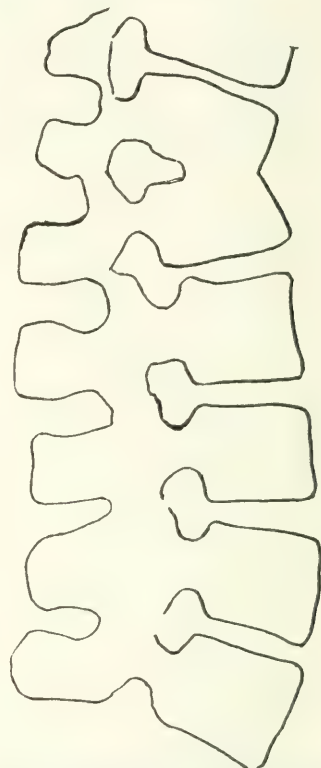


FIG. 12.—Case XIII.—Lateral of lumbar area showing disappearance of disc between the first and second bodies.

sufficiently distinct when examined on the illuminated screen for all clinical purposes, but unfortunately proved not sufficiently clear to photograph successfully for reproduction here. Accordingly tracings of the vertebral bodies were made over the original illuminated plates, and are here shown photographed without alteration.

This limited group of statistics thus gives an incidence rate for the whole of about four per cent., the second period over eight per cent., with the first only two per cent. In spite of the discrepancy between the rates of the two groups, it may be that the rate in the second is nearer the real incidence than the percentage of the combined total, a fair inference being that the brief summaries given in the records for the first period did not indicate all the

findings in each case that might have been observed in a reading of the plates, as found in the detailed reports available in group II. The writer, furthermore, is inclined to put forward the suggestion that the highest figure given may be below the real incidence of this condition. Reasons which may be advanced to support this suggestion are as follows: (1) In almost every case the discovery of the second focus has been more or less by chance, that is neither clinician nor röntgenologist were searching with this in mind. (2) In a very considerable number of these Pott's cases the plates taken

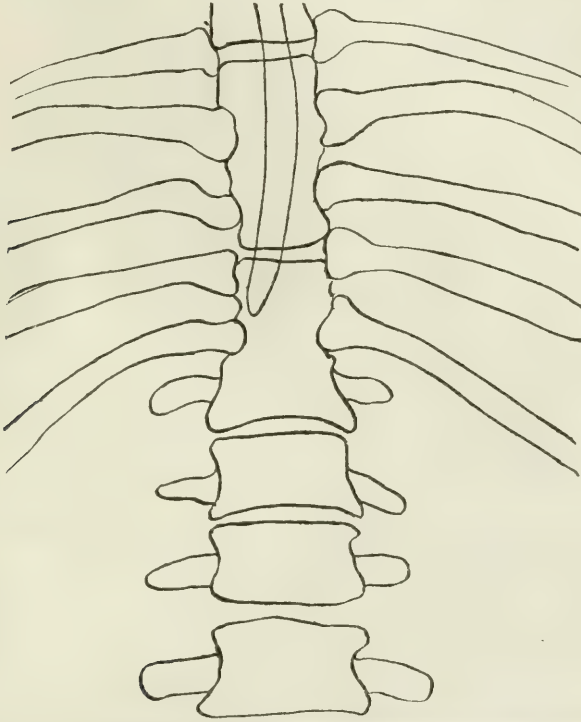


FIG. 13.—Case XIII.—A-P view of lesions shown in two foregoing figures.

included only a very limited area of spine. This procedure may well be open to criticism in view of the present findings, but was practiced for reasons of economic necessity, and because of circumstances about to be mentioned. (3) The majority of the cases had one focus much further developed and probably much older than the other; in other words the major focus may be sufficiently developed at time of examination to be recognized and accurately located clinically. It is generally the custom to send patients with a request for an examination of a specified portion of the spine, the involved vertebra often being named, and the technician, with the same purpose in mind, to get a sharply defined plate, adheres closely to the request, and is unlikely to repeat the exposure over other areas. Hence unless the clinician has demanded an extensive examination, and with a clinically well defined

lesion he has hitherto seen no reason so to do, only a closely adjacent lesion is likely to be discovered by this method. In view of these circumstances, then, it may be that a routine search for further lesions would show a somewhat higher incidence of secondary foci than any of these figures.

From the pathological point of view speculation naturally arises as to the mode of spread of this process. Are the lesions separate hæmatogenous infections from a common distant source such as the alimentary tract; or is the second the result of organisms thrown into the blood stream by the first; or is the new focus a direct metastasis by spread of the bacillus via lymphatic or connective tissue avoiding in some peculiar way the immediately adjacent segment? No definite answer seems possible now. There is certain evidence, however, in favor of the third possibility. In all of the cases found the lesser lesion has occurred at a lower level than the greater, that is, presumably, the subsequent focus below the original. In many the shadow of an abscess was seen around the upper lesion. From this it is possible to imagine a pocket of pus (the "ichor pocket" of the text books) working down next the vertebral bodies, and to conceive of erosion occurring, not in the early stage of formation, but later, when the pocket had reached a slightly lower level and where the pressure would be greatest, such as at an indentation made by the protrusion of a intervertebral disc. In the third case described at the beginning of the paper the two foci were separated by about five normal vertebræ, but in this patient an abscess had apparently formed very rapidly (his symptoms all being of very short duration), filling the iliac fossa, so that this route of spread extended all the way down to the new focus in the fifth lumbar. Such a conception of spread is purely theoretical, but if sufficient attention can be drawn to this general problem, post-mortem evidence may accumulate to explain and substantiate this phenomenon.

From these findings it may be concluded that very careful clinical examinations and a close coöperation between clinician and röntgenologist are indicated in the treatment of tuberculosis of the spine, to rule out the presence of the not uncommon secondary focus. The case cited in which this condition was recognized by the X-ray man and not till six months later by the surgeon has had a well appreciated moral in this clinic. Also that, as the second lesion seems to develop closely subjacent to the first and usually when an abscess shadow is present at the first, attention should in particular be directed toward the spine below an established lesion, and especially in those cases with abscess formation.

In summary it may be said that in tuberculosis of the spine secondary foci, separate but characteristic, are more common than generally supposed, and that a routine search should always be made for such.

NOTE.—The writer wishes to express his obligation to Dr. R. B. Osgood for many valuable suggestions in the preparation of this article.

POSTURE AND THE CERVICAL RIB SYNDROME

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IN 1911-1913 I was engaged in an investigation of the brachial plexus and the skeleton of the shoulder and the thoracic inlet with special reference to the cervical rib syndrome. In this investigation several papers were published dealing with the anatomical features concerned and with the clinical condition itself especially as regards the vascular condition (see bibliography in 9). Certain features of this work have been taken up by others and amplified. In particular it served as the starting point for the very careful researches of Stopford upon nerve injuries in the war (*e. g.*, 6, 7). The relationship of vascular conditions noted in Stopford's cases to nerve injury rests, as did the similar condition found in my own cases of the cervical rib syndrome, simply upon clinical evidence together with the inferences drawn from the detailed innervation of the nerves of the limbs shown in this laboratory by Kramer² and Potts⁴. This is of course insufficient evidence and it was intended to continue the investigation further so that this and other dubious points might receive some elucidation. The claim that degeneration of nerves causes alteration of vessels in the same area has been many times discussed, always with inconclusive results (*e. g.*, Spiller, W. G., 5). Recently Horrax has reviewed the work of the war years upon peripheral nerve injuries¹ and refers to the decortication of arteries as practiced by Leriche. No further review is necessary here but it must be remarked that removal of the fibrous arterial sheath with its contained sympathetic nerves, as carried out by Leriche³ for a distance of ten centimeters or even more, cannot be done without considerable local disturbance. It is not therefore beyond all question that consequences in the limb are attributable to the sympathetic interference and that alone.

Accordingly the outbreak of war found R. G. Pearce and myself engaged upon the destruction of the sympathetic nerves to the forelimb of the dog, a comparatively easy operation without great inconvenience to the animal. Owing to circumstances beyond our control we were unable to finish this work and our results, so far as they went, were negative. It is not intended here to discuss this particular phase of the problem which will be left for the present with the statement that our work is still incomplete. Another line of investigation has however now brought some definite results and it is to this that I desire to draw immediate attention.

It is well known that posture has a definite relation to the cervical rib syndrome. The symptoms occur in the pregnant or recently delivered woman. The position of the shoulder relative to the thoracic inlet has an important bearing upon the subject and the symptoms may equally well occur in the absence of cervical ribs. Altering the posture may bring immediate relief by reducing or removing pressure. It is this relation to posture and the

curious fact that the thumb or even more frequently the index finger first shows indications of the syndrome which determined me to attempt to produce the symptoms posturally so that I might observe the form of onset and possibly the reason for earlier affection of the radial side of the hand. Accordingly in 1913 I formed the habit of sleeping with the right arm stretched out almost vertically under the head. This was uncomfortable for a time but the habit was soon acquired and rapidly became perfectly restful. I had supposed that within a short time some result might be attained but this turned out not to be the case. The posture having become comfortable it was continued with some interruption until March, 1921.

In January, 1921, tingling was noticed in the right index finger and thumb and slight indefinite loss of sensation. There occurred previously a little aching in the course of the nerves along the pre-axial and post-axial borders of the limb both above and below the elbow. It was not possible to determine which nerves exactly were the seat of this aching. The aching is still present at the time of writing (April 9, 1921), but is now confined to the post-axial border immediately above the elbow. Pressure on the aching area causes immediate tingling in the sensory distribution of the ulnar nerve. Similar pressure on the normal left arm evokes no response.

The tingling referred to in the previous paragraph was almost at once aggravated by immersing the hand in hot water. It was a dull irritating sensation, not exactly a pain but comparable with that sensation left after firm pressure on the gum close to the necks of the teeth. One would almost automatically rub the finger; this in no way relieved the sensation but rather aggravated it. Cold did not have an aggravating influence as heat did. This abnormal sensation is still present (April 9th) and affects the entire ball of the thumb but no other part of this digit, the whole of the sides and palmar surface of the index finger, and sometimes the radial border of the middle finger. It does not remain at uniform intensity but varies very greatly and may be absent altogether.

The index finger and thumb became swollen in February, 1921. Along with the swelling there appeared some paronychia, irregular desquamation of the epidermis and unusual separation of the nail from its bed. The last mentioned feature gave the impression that the nails were growing rapidly. Measurement of the weekly growth compared with that of the sound side showed this to be an error. The swelling and paronychia continued until March 30th, when the posture was altered, after which some improvement occurred. Fig. 1 shows the condition of the index finger compared with that of the sound side on March 29th just before the experiment was stopped. Defective nutrition of the nail is apparent in the horizontal wrinkling. The raising of the nail from the finger in consequence of the swelling accounts for the difference in shape of the two nails and the apparent increased growth of the right nail. Irregular desquamation on the same date is well shown in Fig. 2. At first sight it might be thought that the appearance of the right index finger was the result of formalin irritation. My skin has never been



Fig. 1.—Right and left index fingers on March 29, 1921. Note paronychia and defective desquamation on light. The nutrition of the nail is deficient. The difference between the two nails is accentuated by the raising of the right nail from its bed in consequence of the swelling of the finger: there is no increased growth.



Fig. 2.—Same fingers, same date. Note irregular desquamation of epidermis on right.



Fig. 3.—Same fingers April 9th. Note the swelling of the right finger around the nail. This type of swelling with a smooth shiny skin first appeared on April 8th. It has disappeared again by April 12th.

subject to formalin irritation and the hands had not been in formalin for several weeks previous to the appearance of the condition noted.

In association with the paronychia, sensation became increasingly blunt and at first I attributed this to thickening of the epidermis and swelling of the finger. In particular there was great difficulty in finding the keys of a typewriter with this finger which became useless for the purpose. Slight change also occurred in the hand-writing; this may be auto-suggestion. The finger still stumbles (April 9th) on the typewriter in spite of the absence of swelling.

On March 30th, the photographs for Figs. 1 and 2 having been taken, it was considered wise to terminate the experiment by altering the sleeping posture, since the condition of the fingers had begun to interfere with routine duties. The initial symptoms of the cervical rib syndrome had made their appearance and had been duly noted and it seemed unwise to await further symptoms. There had been no cyanosis or any undue heat or redness of the affected parts. Further, if vascular symptoms were to appear later one could not rule out the paronychia as at least a contributory cause and the experiment would be just as inconclusive as previous experiments upon animals. It was, however, April 5th, before duties permitted a full examination of the affected fingers. On that day after suitable precautions had been taken to secure complete quiet and freedom from interruption, the fingers were carefully investigated by a colleague as regards sensation. There was no wasting or apparent muscular disability. The following is the result of this examination.

Tactile sensation.—A small piece of absorbent cotton was used.

Dorsal surface.—A small area of insensitiveness at tip of thumb and distal part of second phalanx index finger near the nail bed. Tingling sensation all over distal phalanx and around nail.

Palmar surface.—Insensitiveness on ulnar margin and adjacent area of ball of thumb, also on ball of index finger. Distinct tingling over distal part of second phalanx. No area of tingling on thumb.

Compass test.—Nowhere on either thumb or index finger was it more difficult to distinguish the separate points of the dividers used than on the normal side. On the radial side of the palmar aspect of the second phalanx of the index finger and on the ulnar side of the palmar aspect of the distal phalanx of the thumb the divider points could be separately felt three millimeters apart. Elsewhere on these digits it was necessary to have the divider points five millimeters apart in order to obtain the double sensation. The same results were obtained upon the normal side.

Pain.—Elicited with a fine needle in a needle holder.

Dorsal surface.—Tingling sensation over ulnar side distal phalanx of thumb and radial side of third phalanx index finger. No loss of sensation.

Palmar surface.—Tingling sensation entire surface second and third phalanges. No loss of sensation. The tingling elicited by stimulation with the needle was exactly the same as that evoked by the absorbent cotton. There was some delay in sensation in occasional spots on

the palmar aspect of both affected phalanges of the index. This may have been due to failure of the needle to penetrate the skin properly. Delay was more frequent and more definite in testing temperature. It was not apparent to light touch or the compass test.

Heat.—Water just boiled was used in a small phial. This necessitated very frequent renewal.

Dorsal surface.—Tingling sensation over entire surface of distal phalanges only of thumb and index finger. Some delay in irregularly placed spots in both locations.

Palmar surface.—Tingling along ulnar margin and adjacent area distal phalanx thumb; and along radial border and adjacent area second and third phalanges index finger. There was in addition tingling in distal part of first phalanx of index only. Some delay everywhere.

Cold.—The test was elicited with ice.

No alteration of sensation. Some delay in radial border third phalanx index finger front and back, and on dorsal aspect ulnar border thumb.

Comparison of this record with the distribution of the median nerve as reinvestigated by Stopford⁸ shows that only some of the fibers are involved.

On April 8th subjective tingling with increased heat in the affected fingers and waves of heat sensation in the arm generally set in. The index finger especially began to swell and the skin to become shiny. This condition lasted through the night but began to diminish next morning. Fig. 3 was therefore made to show the appearance before it should entirely disappear. This was the first indication of any vascular disturbance.

During the month of April occasional attacks of causalgia of even briefer duration occurred. The fingers were in a very sensitive state. Any local irritation, such as the application of formalin or photographic solutions, clapping of the hands or mechanical work in the laboratory shop, would light up a fresh attack. Holding the arm in the old posture for an hour or so would bring about the same result.

At this date (May 5th) the fingers are almost normal once more. There is no loss of sensation and the typewriter can be used as before the symptoms appeared. Apart from a slight hypersensitiveness to heat and irregular desquamation with dryness of the skin there is no disability.

May 16th, the fingers are now healed and sensation is everywhere normal.

The subject of the experiment is thirty-six years old and his history sheet is clean except for infantile disorders and otitis media. He is well built, healthy and weighs 180 pounds. There has never been any tendency to circulatory disturbance or local cyanosis, and the reaction to cold is normal. There is every reason to believe that the prolonged retention of the peculiar sleeping posture, intermittent though it was, has *some* causal relation to the symptoms described. The experiment failed to bring forward any evidence relating to vascular changes and though it emphasized the commencement of the symptoms in the index finger and thumb it suggests no reason for this distribution. That the symptoms rapidly clear on change of posture con-

firms the established method of treating such cases in clinical practice. But the real reason for recording the experiment is the emphasis which it places upon the relation of posture to this symptom-complex with the obvious corollary that appropriate questioning may elicit the fact in certain cases that some apparently simple and harmless habit is really in part the cause of the symptoms which will disappear if that habit be broken.

SUMMARY

It is possible to produce the cervical rib syndrome experimentally by posture alone. Since this is the case it may be the explanation of some instances at least of the disease occurring in the absence of anomalies at the cervico-thoracic junction.

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THE INTRA-ABDOMINAL OPERATION FOR FEMORAL HERNIA

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COMPLETE cure of abdominal hernia entails complete removal of the entire sac and as much as feasible of the adjacent redundant peritoneum above the hernial neck and orifice. No hernia is completely cured unless completely removed. The best incision for sac removal gives safe and most direct access to the neck and surrounding peritoneum through which may be accomplished enucleation and complete removal of the sac with least trauma to the structures involved.

In *Surgery, Gynecology and Obstetrics*, November, 1919, I described an intra-abdominal method of approach to, and removal of the sac and adjacent redundant peritoneum for the cure of inguinal and femoral hernia. By this method these purposes are completely accomplished with maximum safety from injury to the vas deferens, the urinary bladder and large blood-vessels. Adherent and diseased omentum and bowel may be adequately and safely separated from the sac and adjacent peritoneum; other organs and structures in the pelvic portion of the abdomen may be properly explored and treated through the same incision; the cremaster, internal oblique and other overlying muscles and fascia may with minimum trauma be separated from the sac and preserved for utilization in wound closure; during the final stage of enucleation, the sac and adjacent peritoneum are pulled upward away from the hernial orifice and canal and away from the bladder and large blood-vessels; and finally after excision of the sac and redundant adjacent peritoneum about its neck, the peritoneum may be sutured to structures well above and away from the previous hernial orifice. This latter consideration has obvious advantages over the method of making traction from below through which there is some liability, during ligation or suture, even by experienced surgeons, of unintentional anchorage of the peritoneum to fascia or muscle in the region of the hernial orifice or canal, to be followed by prompt return of the hernia or at least bulging at the site of the orifice.

There are some additional advantages of this method of approach incident to the location of the skin incision above the zone of infection within the hairline and from the fact that with the finger, a piece of gauze or blunt instrument within the sac, the line of cleavage between the sac and overlying muscle and fascia is more easily identified and enucleation more quickly accomplished with the least mutilation of overlying muscle and fascia.

Finally, with the field of operation entirely open, the surgeon may, after close inspection, choose the most suitable method of wound closure (canal obliteration), and whatever plastic procedures may seem useful in the individual case.

Many surgeons of large experience and good judgment have expressed



FIG. 1.—A large-sized femoral hernia.

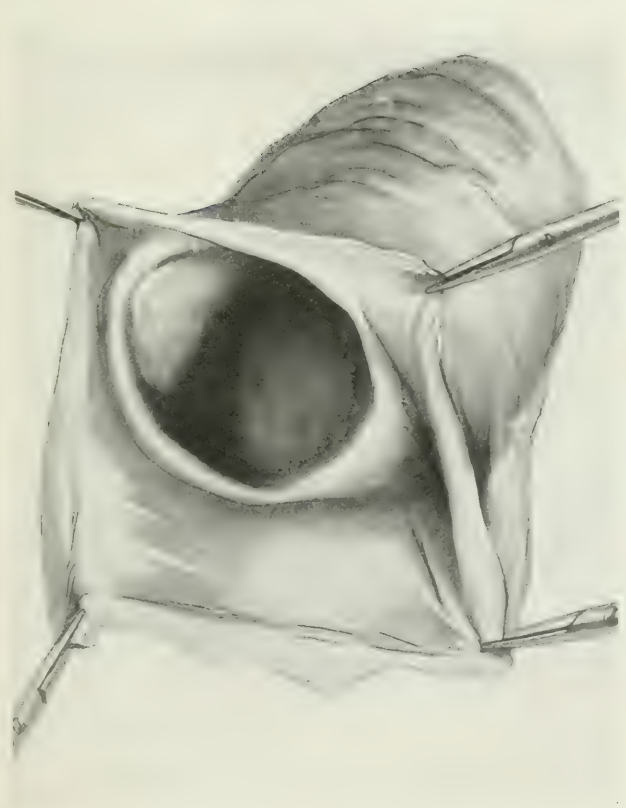


FIG. 2.—The sac of the femoral hernia with one to two inches of surrounding peritoneum after removal.

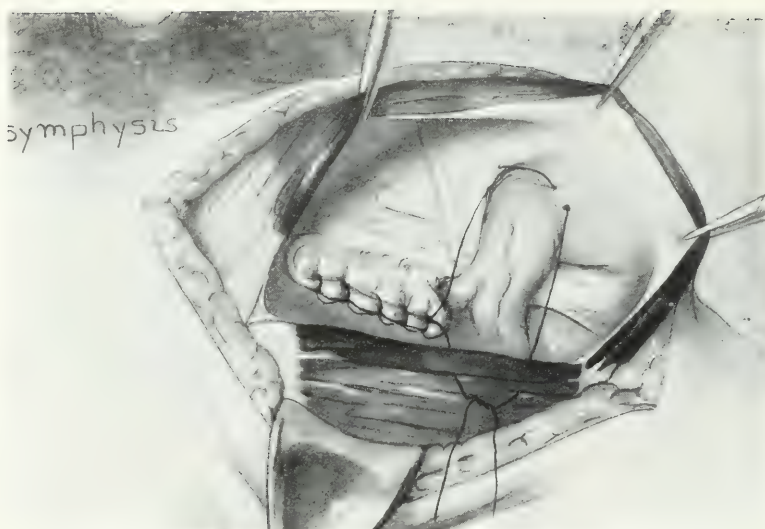


FIG. 3.—The sac and adjacent peritoneum has been removed, the cut edges of the peritoneum sutured and about to be tacked to the parietal peritoneum at the position of the internal inguinal ring and anterior abdominal wall. The femoral orifice and canal in this case easily admitting two fingers side by side, was not closed.

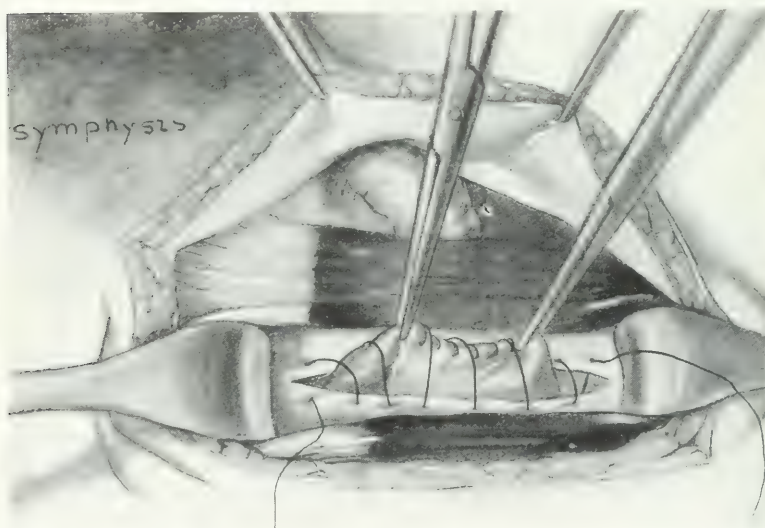


FIG. 4.—The sutured peritoneum from the region around the previous location of the neck of the hernia is now being sutured to the original incision of the peritoneum just above the inguinal ring. This suture passes through the stump of sutured peritoneum as it is held up by forceps. This does not appear to be the case in the drawing for the reason that in this particular case the sutures were passed through from the lower side.

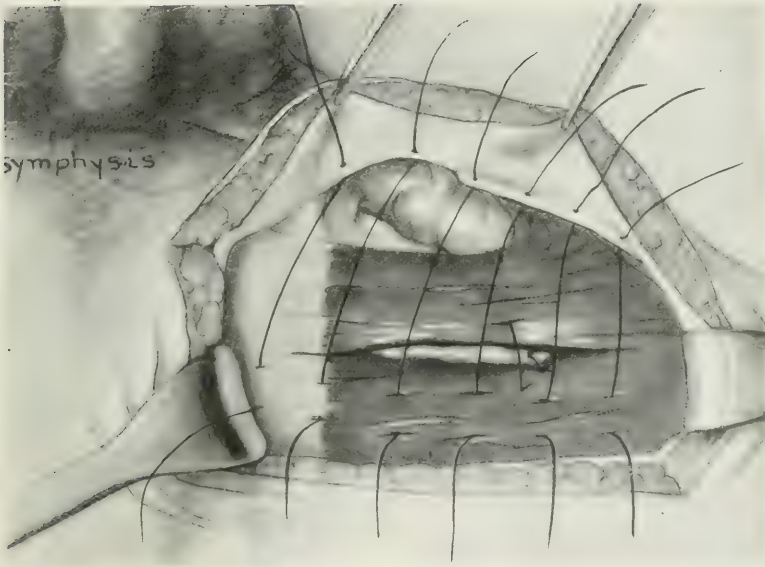


FIG. 5.—In the final closure of the split made in the internal oblique and transversalis muscles the lower end of the suture catches the under surface of Poupart's ligament. These sutures are very loosely tied and under no circumstances should they exert tension on the muscle fibres. To avoid atrophy of the little bundle of fibres on the lower side of the split, these are not caught in the suture.

their approval of this method of approach to the sac in dealing with herniæ of large size with contents adherent and in other ways complicated and difficult to cure, and for operating on recurrent cases (cases in which at the first operation the sac had been incompletely removed). With their stamp of approval of the usefulness of the method for large, difficult and complicated cases, I am encouraged in the belief that the method is best suited for all cases. No one has suggested that the intra-abdominal approach is difficult or dangerous. From an experience of operating upon more than three hundred cases of all types of inguinal and femoral hernia by this method, I can testify that the sac and adjacent peritoneum is more easily and completely removed from within than from without; and after painstaking effort I am unable to find a single patient who subsequently developed hernia.

After complete removal of the sac and redundant peritoneum above its neck and the highest practicable suture of the cut edges of peritoneum, problems of "orifice closure" and "canal obliteration" are problems of wound closure. This should be accomplished by the method which permits restoration nearest to anatomic and physiologic normalcy of the muscles and fascia stretched by the protruding hernia and cut and separated by the operative procedure.

The method of Halsted, as described by his pupil, Taylor (*Archives of Surgery*, September, 1920), is a perfect application of the principles of biology to the form and function of the muscles involved in inguinal hernia and solves the problems referable to the repair of the abdominal wall in relation to the inguinal canal. Indeed certain other methods of "canal obliteration" are quite adequate for this accomplishment, and, provided the sac and adjacent peritoneum are completely removed and the wound heals without suppuration or tissue strangulation and atrophy, are followed by cure of hernia without subsequent bulging.

After removing femoral hernia there are many methods of orifice closure and canal obliteration, probably none of which are necessary (Ochsner), if all the sac and adjacent redundant peritoneum about its neck is removed.

In curing umbilical hernia there is no canal to be closed. The operation consists solely of removing the hernia with its orifice and closing the wound.

The pictures here reproduced are the finished product of sketches made at the time of operation upon the case of femoral hernia herewith illustrated.

The incision is made through the skin, superficial fascia and aponeurosis just above the location of the internal inguinal ring. The fibres of the internal oblique and transversalis muscles and fascia are separated in the usual muscle-splitting fashion, making a good exposure of the peritoneum; this is then picked up and opened in the usual way. After retracting the edges of the wound, the neck of the hernia is adequately exposed from within the general peritoneal cavity. Adherent omentum and bowel can be completely and easily removed and a thorough exploration of this region of the abdomen is easily made.

With the finger or a pair of blunt curved forceps in the hernial sac from above, enucleation aided externally by a gauze-covered finger or sharp dissection is easily accomplished and the femoral and other large vessels are quite safe from injury. The sac being freed is easily turned inside out into the peritoneal cavity. The sac and redundant peritoneum in the region are pulled well upward, clamped sufficiently high to take up all the redundant peritoneum and excised. In this way the entire sac and from one to two inches of the surrounding proximal peritoneum are removed. The cut edges of the peritoneum are then sutured. It has seemed advantageous to tack the sutured portion to the position of the internal inguinal ring and to the edges of the original incision in the peritoneum. This effects practically a transplantation of the peritoneum away from the region of the femoral orifice and brings the raw surface of sutured peritoneum out of contact with bowel and omentum. The split muscles are then loosely sutured and in a hernia of small size this is perhaps all that is necessary. I have, however, made it a plan in herniæ of large size to catch the under surface of the aponeurosis with sutures placed very loosely in the manner as if closing the inguinal canal. Great care should be exercised in tying them merely to hold structures without tension.

I have never made any effort to close either the femoral canal or the femoral orifice. In the patient here illustrated the femoral canal would admit two fingers side by side. We could feel nothing resembling Gimbernat's ligament. The patient here illustrated was operated upon in October, 1920, and recently has been thoroughly examined. There is no evidence of hernia. I have operated in this manner upon twelve cases of femoral hernia. All are cured, the first case over five years, the last case counted in this report, more than six months.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held October 12, 1921

The President, JOHN A. HARTWELL, in the Chair

CRANIOPLASTY FOR LARGE TEMPORAL DEFECT

DR. DEWITT STETTEN presented a boy fifteen years of age, who four years ago, as a result of an automobile accident, sustained a severe depressed fracture of the skull in the right temporal region. A decompression trephining was performed at the time and apparently a considerable portion of skull was removed at the site of injury. The patient was left with a very large pulsating hernia of the brain, which after some time cicatrized and epithelialized. This protrusion gradually increased so that when the patient came under observation in February, 1921, it was the size of a large fist and covered by a broad, flat, glossy and thin scar, entirely denuded of hair. A photo of the boy taken in March, 1919 (Fig. 1), gives some idea of the protrusion. The herniation, when the patient was first seen, was about half again as large as is shown in the picture.

Mentally, the boy was a trifle subnormal. He had no headaches or convulsions. There was a paralysis of the right frontalis muscle. The X-ray examination of the skull shows a bony defect involving almost the entire squamous portion of the temporal bone (Fig. 2). The defect is irregularly circular in shape, with an average diameter of about 5 cm. The edges seem quite smooth and regular.

The chief complaint was that the protrusion interfered with the normal life of the patient. Its unsightliness was a constant source of embarrassment, and the fear of injury kept him from the usual activities of a boy of his age. It almost appeared as if the slight impairment in his psychical development was due more to these factors than to any organic cerebral injury or defect.

After a consultation with Dr. Joseph E. J. King, operative interference was decided upon.

On March 11, 1921, a preliminary scalp plastic was performed. The scar was excised by an elliptical incision. Hemorrhage was controlled easily by self-retaining retractors. A large cyst, filled with clear fluid, which represented a considerable part of the hernia, was opened. Its external wall was excised and the inner wall was cauterized with carbolic acid and alcohol. The edges of the cyst wall were sutured together. The scalp on either side was freed widely from the pericranium until the edges of the wound could be nicely approximated without tension, and the wound was closed. The wound healed

satisfactorily, leaving an almost linear scar and the protrusion was now insignificant.

On April 7, 1921, the actual cranioplasty was undertaken. It was planned to use a free pericranial-cranial transplant utilizing the outer table of another part of the skull. This method was originally proposed by Schmieden and has been used with much success by King, Frazier and Coleman. Doctor King was good enough to assist at the operation and gave invaluable help and advice. Ether anæsthesia was used. The head was so draped by fixing the towels to the skin with a crown of towel clamps that both sides of the head could be brought into the aseptic field. The defect was then prepared. The scar was excised. The pericranium was incised 0.5 cm. beyond the edges of the bony defect and the margins exposed. The dura was freed with a blunt separator. The hernia was reduced and oozing controlled by bridge sutures. The margins of the defect were freshened and all irregularities removed by beveling with an osteotome at a 45-degree angle. A linen pattern was cut and the outer side marked with a suture. The head was turned and through a straight incision over the left parietal eminence the pericranium was exposed and the pattern laid over it. The pericranium was incised around the pattern about 0.5 cm. beyond its edge down to the skull. The protruding edge of pericranial flap was turned over on the pattern and the bone flap of the outer table was cut to correspond to the pattern. The circumference of the flap was first cut and then the osteotome was directed from the periphery toward the centre of the transplant. The edges of the transplant were beveled at about a 45-degree angle to correspond to the margins of the defect and the thickness of the bone was approximately 0.25 cm. This cutting of the bone flap is technically the most difficult part of the operation. The bone graft was somewhat chipped and broken, but in the main was still adherent to the pericranium. The free pericranial-cranial transplant was laid in the defect with the raw bony surface down, and pericranium sutured to pericranium. Both scalp wounds were carefully sutured, the angles being drained by small tubes, which were removed after forty-eight hours. In the short time allotted for this presentation one cannot cover every point in the technic of the operation, but for further details on the subject reference may be made to a recent publication of Doctors King and Anderson ("Cranioplasty: Indications, Operation and Results," *Southern Medical Journal*, 1920, xiii, 719-733).

The patient showed some evidence of shock after the operation, but quickly recovered. He vomited a good deal and had a moderate headache, probably because of the increased intracranial tension, but after two days these symptoms subsided. The wounds healed by primary union and the graft took, leaving a flat, smooth and solid skull where the defect had been. The X-ray taken one month after operation (Fig. 3) shows the defect completely filled in with new bone, almost as dense as the rest of the skull. About two weeks after operation the patient had a rather severe headache for twenty-four hours, but since then there have been no headaches, convulsions or symptoms of any kind referable



FIG. 1.—Photograph of patient taken in March, 1919, showing cerebral hernia and scars.



FIG. 2. X-ray before operation, showing temporal defect.



FIG. 3.—X-ray taken one month after operation, showing defect filled with new bone.



FIG. 4.—Photograph of patient taken in September, 1921, five months after operation.

to the head. One can now feel a slight groove anteriorly between the skull and transplant, but the solidity of the plastic has remained and hair has covered the major part of the scar, giving the head quite a normal appearance (Fig. 4). The area from which the transplant was taken cannot be differentiated from the rest of the skull. The patient's mental condition seems improved, mainly because his unsightly and disabling deformity has been removed.

DR. J. P. HOGUET reported a case somewhat like that of Doctor Stetten. The man had been through the war, came home, and was a welder. While doing acetylene welding the tank blew up and a piece of metal struck him in the left frontal region. He was taken to a Newark hospital, where it was said the bone was so extensively comminuted that nothing could be done except to take out a few fragments. It seemed that the first nerve endings had been cut, as he had no sensation of smell or taste. He consulted Doctor Hoguet on account of persistent headaches and a feeling of insecurity and wanted something done to give him relief. Doctor Hoguet operated on him in March, 1921. He cut through the old scar, and except for the exact underlying region where the scar was slightly adherent, it peeled off easily from the dura. He freshened the edges of the cleft with rongeurs and separated the pericranium, pushing it back a little beyond the edges of the cleft. He then made a pattern of the defect on a piece of muslin. Following this pattern he removed a graft from the antero-interior aspect of the tibia, the graft being from one-eighth to one-quarter of an inch in thickness. It fitted into the cleft fairly well, leaving a little gaping. He sutured the periosteum of the graft which had been left a little wider than the graft to the pericranium around the defect. The graft soon became absolutely firm. He dressed the wound every day in order to observe the progress, and noticed that the first three or four days the graft could be moved up and down slightly. It rapidly became more and more solid until at the end of a week it appeared to be as firm as the rest of the skull. The headaches and feeling of insecurity completely disappeared.

DR. CHARLES A. ELSBERG said that he had had occasion to close quite a number of cranial defects by cranioplasty. He very rarely made a complete transplant. He usually enlarged the incision, chiseled off the outer table of the skull covered by periosteum, and either turned it around and fixed it in the defect or turned it down as a flap with the periosteum inside of the skull. This latter procedure is to be considered advisable when there is a defect in the dura, so as to prevent new-formed callus from irritating brain tissue. Doctor Elsberg stated that he also had been surprised at the remarkable rapidity with which these grafts of the outer table of the skull healed in place, so that within a few months very little abnormal could be seen in the X-ray picture.

DR. JOSEPH E. J. KING said that the first cranioplasty he saw was in 1915 when he assisted Dr. Hermann Fischer at a base hospital in Germany. That operation was performed according to the König-Müller method, that is,

by sliding an adjacent pedicle flap, consisting of the entire thickness of the scalp and portion of the outer table of the skull, over the defect, in so doing the bony portion of the flap was practically detached from the soft parts of the flap, the bony portion was placed in the defect and the flap sutured over it. In this case the bony portion took and the defect was corrected. After seeing the difficulty of removing the flap, he wondered why a complete pericranial osseous transplant would not do as well.

In 1916 he operated upon several cases and used such a transplant from the tibia. Later he visited Doctor Schmieden's clinic in Holland and found that they were using cranial grafts which were removed from the skull by an extension of the incision when possible. This type of operation was used in the neuro-surgical services at Cape May and Fox Hills by Doctor Frazier, Doctor Coleman and himself. The graft was placed with the bony side downward; they did not turn the graft upside down as Doctor Elsberg did. Doctor Bagley, at Fort McHenry, operated upon his cases and reversed the graft in the manner spoken of by Doctor Elsberg. The results reported were about the same as when the graft was not reversed. It seemed that it made but little difference in the result whether the defect was closed by the one or the other of these methods.

Doctor King said he felt that a word should be said in regard to the contra-indication to cranioplasty. A cranioplasty should not be done in the presence of sepsis. One should wait at least three months after absolute healing had taken place, and in some instances this is not sufficient length of time. In some cases one should wait six months or a year. In those cases in which a foreign body was retained, the defect should not be closed until the foreign body had been removed. Those cases, in which the brain had been penetrated and a tract had been left, should not be closed. The ideal case for cranioplasty was the deep fracture where there was no laceration of the brain tissue and where the patient was practically symptomless, with the exception that he had a hole in his head. Both Doctor Elsberg and Doctor Hogue had spoken of the rapidity with which the graft healed in the defect. These grafts really seem to cement themselves into the defect and form a solid closure. Doctor King said they had had about eighty-four such cases and he had seen but one instance in which the graft was absorbed. In that case the patient had post-operative pneumonia followed by a right-sided empyema, due to the hæmolytic streptococcus. The graft had become absorbed after about four months, leaving the defect exactly as it was before the operation was done. A second cranioplasty was performed by this time under local anæsthesia. This graft healed in, and remained as long as the patient was observed in the hospital, a period of about three months.

Doctor King expressed the opinion that it was preferable to use a transplant from the head. It was more convenient and there was but one incision necessary in a number of cases. In cases where there is a frontal defect it will be necessary to make two incisions, a second one over the parietal eminence for the removal of the graft. In such a case it would not be advisable

INOPERABLE CARCINOMA OF BREAST

to extend the incision over the posterior part of the skull. If the defect was a long narrow one it was better to use a tibial graft. So far as the results were concerned he had noticed no difference between the cranial and tibial grafts.

INOPERABLE CARCINOMA OF BREAST. UNUSUAL RECENT RESULT FOLLOWING X-RAY RADIATION

DR. BURTON J. LEE presented a woman thirty-one years of age, who first was admitted to the Memorial Hospital on March 7, 1921, with a very unusual type of breast carcinoma. She had had one child, seven years of age. In November, 1918, an ulcer appeared on her upper lip, which remained unhealed for four months. A positive Wassermann was obtained. The patient was treated with hypodermic injections of mercury for a period of one year. Shortly after the beginning of treatment she began to show scaly areas upon the hands and pigmented spots over the surface of the body, which were presumably luetic. All of these symptoms subsided completely under treatment. In June, 1920, she noticed a tender swelling of the right breast, situated in its upper, inner portion. This proved to be an abscess, which was incised and soon healed.

In August, 1920, a reddish, raised area appeared over the upper, inner portion of the right breast. This gradually spread until it involved the skin over the major portion of the right breast, running somewhat over to the left. Posteriorly it had extended well around to her axilla. Her chief complaints upon admission were pain in the right breast, the presence of a mass in her right axilla and a general feeling of malaise. She seemed fairly well nourished and was of sallow complexion. Both breasts were very full and heavy and quite indurated. Both were movable on the deeper parts. The skin over the right breast was a brilliant red and contained numerous small elevated areas that looked almost vesiculated. This reddened area extended well up toward the right clavicle; over as far as to the nipple line of the left breast and to the right as far as the midaxillary line. Inferiorly it reached the rib margin.

In some places the line of demarcation between this reddened area and normal skin was quite distinct. In others it merged gradually into normal skin. The measurement horizontally of this whole reddened area was 52 cm.—vertically 38 cm. In both axillæ there were large, hard, movable nodes. In the right side of the neck there was also a chain of nodes extending two-thirds of the distance from the clavicle to the mastoid. The left supraclavicular region showed no involvement of nodes. There was a scar of the lesion mentioned, in the past history, over the upper lip.

The patient was treated entirely by X-ray radiation by Doctor Herrendeen, the radiologist of the Memorial Hospital, the first treatment being given on March 7, 1921, with a six-minute time exposure; a current of 5 milliamperes; a filtration of 4 millimetres of aluminum; using a 9-inch spark gap and a 10-inch focal distance. Treatment given over the right breast anteriorly and laterally.

At two-day intervals the supraclavicular and axillary regions were similarly treated.

Beginning April 6, 1921, a second cycle was given, being confined entirely to the involved skin area. Time exposure was four and a half minutes; with a current of 7 milliamperes; a filtration of 3 millimetres of aluminum; using an 8-inch spark gap and an 8-inch focal distance.

Four additional treatments have been administered—one on June 24, 1921—time exposure being 12 minutes; current of 4 milliamperes; filtration—3 mm. of aluminum; 10-inch spark gap; and 12-inch focal distance. Three other similar treatments were also given on July 15th, August 8th and September 6, 1921, save that the time exposure was for fifteen minutes.

A section removed from the reddened area over the upper mesial portion of the lesion was pronounced by Doctor Ewing to be "mammary cancer invading the lymphatics of the derma." Nothing in the pathological examination suggested a syphilitic element in the lesion.

Doctor Ewing's pathological report on the case was as follows: "Sections of the skin and subcutaneous tissue reveal a cellular carcinoma invading the lymphatics just beneath the epidermis, about the hair and sebaceous follicles, and about the blood-vessels of derma and subcutaneous tissue. These lymphatics are everywhere filled and often distended with masses of large polyhedral cells with hyperchromatic nuclei. They resemble the cells of mammary duct carcinoma. About the lymphatics there are many lymphocytes, some of which are also found lying among the tumor cells. There is considerable congestion of small blood-vessels and much oedema, but no definite hemorrhages can be seen. The epidermis is thin and scaly but otherwise unaltered. The endothelial cells of the invaded lymphatics appear unchanged."

A radiograph of the chest made by Doctor Herrendeen on March 7, 1921, showed no definite evidence of carcinoma. A second plate made June 6, 1921, revealed evidence suggesting carcinomatous metastases. No further plate has been made to date.

A Wassermann reaction—April 4, 1921,—gave a two plus result.

The last note made upon the patient was on September 12, 1921, Whereas her weight upon admission was 134½ pounds, it was 158½ pounds on this date. There was a marked disappearance of the superficial lesions, but there were still three small superficial masses attached to the upper, lower and outer portions of the right breast. The right breast itself seemed heavy, but no distinct tumor could be made out of it. The left breast also seemed firmer than normal.

In the right axilla there was a mass of nodes, and there was a similar mass in the left axilla.

The patient was shown as a very unusual type of primary inoperable mammary carcinoma and to illustrate also the marked regression possible in a superficial lesion treated by proper X-ray radiation.

Doctor Lee believed that the patient would finally probably succumb to her disease, but felt that the treatment by X-ray radiation had certainly given a very interesting palliative result to date and had undoubtedly helped to prolong the life of the patient.



FIG. 5.—Dr. Lee's case of carcinoma of breast, original appearance before treatment, March 7, 1921.



FIG. 6.—Results in four months after beginning of treatment.



FIG. 7.—Results six months after beginning of treatment.

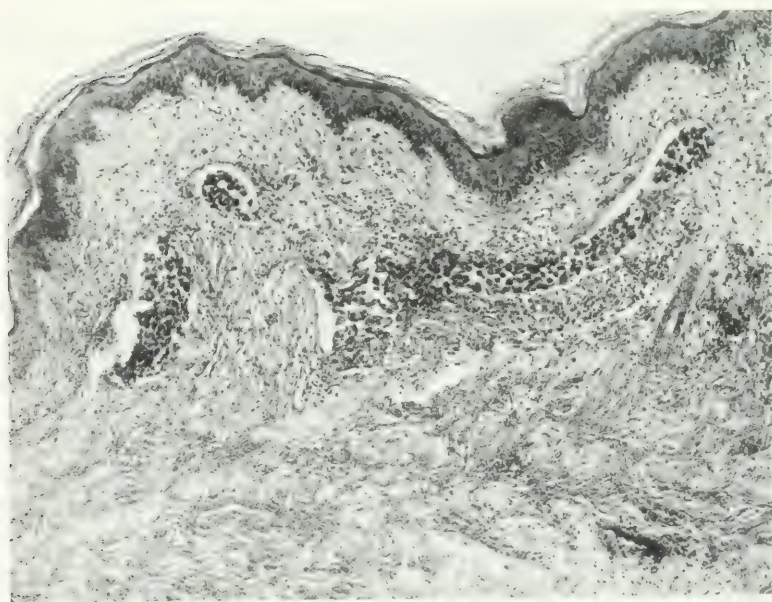


FIG. 8.—Microphotograph from Dr. Lee's case of inoperable carcinoma of the breast.

BRANCHIAL FISTULA

DOCTOR LEE said that the patient represented a rather unusual type of carcinoma. They had, however, seen four or five cases of the pseudo-inflammatory type of breast cancer, but here there was a diffuse redness and a blush over the large area of skin involved. He had never seen quite this picture. So far as the type of carcinoma was concerned, it certainly was not an adenocarcinoma. The disease was rapidly infiltrating, was very cellular and had spread rapidly into all areas. So far as removing a section from the breast itself was concerned, the patient had been unwilling to allow incision into the gland. He believed she would soon consent to the removal of one of the axillary nodes which would probably furnish additional pathological data. She had received no anti-leucic treatment since her admission to the clinic, though she had been treated before the appearance of the breast lesion.

Doctor Lee stated that they had seen a number of cases of carcinoma that responded readily to X-ray treatment, but most of them soon showed a reappearance of the lesion, and the process went on at the same rate as before treatment or sometimes more rapidly. He would be glad to report on this case later. He thought it was proper to criticize the diagnosis of breast carcinoma without a section from the breast itself, though he believed there was little doubt that that was what the patient had.

BRANCHIAL FISTULA

DR. HOWARD LILIENTHAL presented a man twenty-six years old, who entered Mount Sinai Hospital May 5, 1920. His tonsils were said to have been removed in June, 1919, but tonsillar tissue was still present. The patient had a congenital discharging sinus over the lower part of the anterior portion of the sternomastoid muscle. The discharge was sometimes muroid and again purulent. A fine probe passed upward through this tiny orifice for four or five inches and the probing excited reflex cough. There were palpable lymphnodes on both sides of the neck and in the axillæ and inguinal regions.

On May 6, 1920, Doctor Lilienthal operated, general anæsthesia preceding the operation by an injection of concentrated solution of methylene blue into the sinus. None of the dye appeared in the patient's mouth. He incised the skin around the little orifice so as to mobilize the fistula. Traction upon the mobilized part made it possible to palpate through the skin a cordlike mass running upward and slightly backward. The incision was carried from the fistula upward and backward to the angle of the jaw and the fistulous structure was easily followed to this point where it appeared to widen and to proceed toward the pharynx. It was covered throughout with longitudinal muscle fibres which contracted actively on deglutition, drawing the entire mobilized cyst upward with a cremaster-like action. This muscle was now dissected off and methylene blue was injected into the higher part of the canal with a hypodermic syringe. The dye appeared immediately in the mouth behind the right tonsil. Through an incision in the wall of

the tract he easily passed a filiform bougie into the patient's mouth and tying a piece of strong silk to the buccal end of the bougie he drew it out through the wound in the neck, leaving a long piece protruding through the mouth. The external end of the silk was then tied firmly around the wall of the sinus at the fistula and drawing upon the end which protruded from the mouth he was able to invert the entire tract and to cut it off, leaving a very short stump close to the mouth. The external wound was closed with drainage by means of a small-calibre tube which reached from below to the pharyngeal wall.

Healing was rapid and when the patient was seen on June 25th was complete. Strong pressure behind the angle of the jaw would cause the appearance of a minute opaque bead in the mouth. The patient is now entirely well. There is no discharge anywhere, but in the mouth behind the right tonsil, a minute papilla marks the location of the oral aperture of the sinus.

DR. FRANK S. MATHEWS stated that there are described a number of dissections of fistulas of the second branchial cleft which have shown that the fistula passes between the external carotid artery in contact with the internal jugular vein and pneumogastric nerve before entering the wall of the pharynx. The close relations of these important structures add greatly to the difficulties of dissection and show the wisdom of employing the method recommended by Doctor Lilienthal.

DR. SEWARD ERDMAN said Doctor Lilienthal had spoken of the branchial cyst in this case opening into the pharynx. He had recently seen a thyroglossal cyst which opened into the pharynx. Thyroglossal cysts were not uncommon. This one occurred in a young girl. It was egg-shaped and lay between the thyroid and the hyoid bone. It was red, tender and swollen. After pressure on the cyst the girl said she felt a discharge come into her mouth. On examination it was found that pus welled up at the base of the tongue. Doctor Erdman said this was the first time he had been able to demonstrate a patency of the thyroglossal duct, through the foramen cæcum of the tongue.

DOCTOR LILIENTHAL, in closing the discussion, said that this fistula must have gone in the direction Doctor Mathews mentioned. In dissecting he had kept pretty close to the muscle covering the structure. He did not go to the end of the tract because he thought the dissection would become more and more tedious and troublesome, so he tried to invert it into the mouth to avoid this. Thyroglossal fistulæ were much simpler so far as the actual dissection goes than branchial cysts because one is less likely to strike any important structure. Doctor Lilienthal said he had had a number of these cases, but this was the only one that had come to him first; all the others had come to him after others had treated them and after there had been infection. The branchial fistulæ were more difficult to get out than the thyroglossal because they were apt to have ramifications which made the problem of their removal more serious.

SPLENECTOMY FOR PERNICIOUS ANÆMIA

SPLENECTOMY FOR PERNICIOUS ANÆMIA

DR. J. M. HITZROT reported the case of a woman, aged thirty-six, who was admitted to Doctor Connor's service, New York Hospital, September 25, 1920, complaining of weakness, numbness, throbbing in head, stomach trouble. Present trouble began five months ago with feeling of weakness, belching of gas and swelling of the ankles. Her appetite became very poor. Condition has increased steadily up to her admission. Menses negative—normal. Important points on physical examination were lemon color of skin, general anæmia. Teeth gone. Heart—soft systolic murmur at apex. Lungs negative. Abdomen negative except for small umbilical hernia. Spleen was considered palpable by some members of the staff and not by others. Pelvic negative. Hæmoglobin, 30; red blood-cells, 1,000,000; white blood-cells, 1300; polymorphonuclears, 41 per cent.; lymphocytes, 47 per cent.; eosinophiles, 2 per cent. Occasional normoblast. No increase in blood platelets. Stomach: Total acid 1.6; free HCl 0.8. Lactic acid negative. Guaiac tests negative.

Fluoroscopic (Doctor Holland): Heart, liver and œsophagus negative. Stomach orthotonic, hooked, good position. No defects or spasm. Negative for organic change.

Stool examination negative for parasites or ova.

September 28, 1920: Transfusion 350 c.c. blood; chill.

October 8, 1920: Transfusion (from another donor) 400 c.c. blood; no reaction.

October 24, 1920: 300 c.c. from first donor; same reaction.

November 5, 1920: Transferred to First Surgical Division.

November 8, 1920: Operation, splenectomy. Spleen three times normal size. Perihepatitis. Gall-bladder thick walled, containing stones, removed between clamps. Small subserous fibroid in uterus. Appendix normal; not removed.

Discharged eighteenth post-operative day; hæmoglobin 55 per cent.; red blood-cells, 3,000,000.

Culture from gall-bladder sterile.

Condition has remained stationary since then.

Blood, October 3rd: Hæmoglobin, 45 per cent.; red blood-cells, 2,500,000. Numerous normoblasts. The symptoms existing before.

DOCTOR LILIENTHAL said that he had done a number of splenectomies, although only one in a case of pernicious anæmia. That patient died of morphine poisoning after the operation.

Doctor Lilienthal asked Doctor Hitzrot what type of blood transfusion he employed. He said he asked this particularly because of the chill that so often followed transfusion by the citrate method, the reply being made that the citrate method was used.

DOCTOR LILIENTHAL expressed the opinion that in primary blood disease it was better not to use the citrate method but to use whole blood. He said he had formerly used the citrate method following pulmonary lobectomy. He formerly did a blood transfusion after lobectomy because there was a

huge outpour of bloody serum into the pleura for the next forty-eight hours following the operation. It was equivalent to the loss of a large amount of blood because the fluid contained as much as 10 per cent. hæmoglobin. That loss had to be replaced, so he had used blood soon after the operation. He had had two cases in which death occurred with a terrific rise in temperature after transfusion immediately following lobectomy. There always seemed to be more or less reaction following transfusion by the citrate method after lobectomy; so he had given up all except the direct methods. He preferred one of the syringe methods which had less danger of reaction than the citrate method. Whether the citrate method acted as well as whole blood in primary anæmia he was not enough of a hæmatologist to say, but he would like to hear what others had to say on that point.

DR. FRANZ TOREK said it would be encouraging to hear of a case of pernicious anæmia successfully treated by splenectomy. In the case reported he did not hear any mention of the presence of megalocytes or megaloblasts in the blood. To his understanding a case of anæmia could not be diagnosed as pernicious anæmia unless the blood contained megalocytes and megaloblasts. Doctor Torek reported a case of his own of pernicious anæmia in which he performed splenectomy. The patient was a Russian, twenty-seven years of age, ill for three years with the characteristic clinical symptoms of pernicious anæmia. When he came to the hospital his blood count was hæmoglobin 40 per cent., red blood-cells 1,900,000, white blood-cells 2400. Megalocytes and megaloblasts were present. The patient had all the characteristic symptoms, a sallow yellow appearance, such general symptoms as weakness, loss of appetite, loss of weight, constipation, headaches, dyspnœa, slight œdema, polyuria, blood in the urine and blood in the stools. The stools were examined and no bothriocephalus ova were present. The patient was transferred from the medical department to Doctor Torek's service. He operated on him on October 2, 1920. He had a very normal post-operative course. After about two weeks his wound was completely healed and he was retransferred to the medical service. While in the surgical division blood studies had been made practically every day, and later quite frequently until he was discharged after the medical division had studied him about a month longer. When he was discharged he felt distinctly better, though the blood examination showed no improvement whatever, either as to the degree of the anæmia, the number of red cells remaining as low as before, nor as to the kind of anæmia, for he still had megalocytes and megaloblasts. He went out and took a job which required about two hours of work daily. Doctor Torek mentioned this because before his admission to the hospital he had been unable to work for two and a half years. Three months later he returned to the hospital. His blood count was then 10 per cent. of normal. His symptoms were mostly gastric. He died about eight days after admission. The autopsy showed a hypertrophied heart, parenchymatous nephritis and the cause of death was pernicious anæmia. The appearance of improvement was probably nothing more than one of the remissions one sees in cases

of pernicious anæmia without treatment. Sometimes remissions last quite a long time whether the patient is treated by splenectomy and transfusion or not.

Doctor Torek added that the incision he had used in doing the splenectomy was one he had devised but had never published. It began at the ensiform cartilage, ran along the left costal border and extended to the posterior axillary line or still further back. The front part of the incision passed outward and downward and the back part ascended again. This incision permitted raising the costal arch, giving good access to diaphragmatic adhesions and bands. It was a combination of the anterior costal incision and the oblique lumbar nephrectomy incision. It had one drawback in that more blood-vessels had to be secured than with the rectus incision, but this was more than counterbalanced by the greater ease with which one could handle adhesions and the greater access to the entire region. Where the spleen was movable the ordinary rectus incision was satisfactory.

DR. RICHARD LEWISOHN stated that they had had occasion to test the different methods of blood transfusion in pernicious anæmia, using citrated and uncitrated blood, and they had found that it was really not the method which played any rôle in the effectiveness of transfusion, but it was the time at which it was done. In the early stage any method would be effective, but if one got a case of pernicious anæmia in the late stage no method would be of great benefit. Doctor Lilienthal mentioned chills following citrate transfusion. There was no doubt that among the citrate cases a larger percentage had chills than among the non-citrate cases, the percentage in which chills occurred being twenty-five in the citrate cases against five in the non-citrate cases, but no method of blood transfusion was free from chills. Doctor Neuhof, who administered 6 to 8 grams of sodium citrate intravenously for the prevention of hemorrhage, did not observe one chill among 100 cases. The real cause of the chills still remains unknown.

CORRESPONDENCE

FRACTURE OF THE METATARSAL BONES—BLOODLESS REDUCTION

EDITOR OF ANNALS OF SURGERY:

SIR:

IN the ANNALS OF SURGERY, August, 1921, page 214, there is an article on "Fracture of the Metatarsal Bones," with a report of four cases. These fractures were all reduced by open operation, and in only two cases, according to the histories, "an attempt was made to reduce the fractures and dislocations under ether anaesthesia without success." In conclusion the author writes: "If there be deformity sufficient to markedly destroy the convexity of the bones, especially if more than one bone is broken, or the fracture includes the second and third metatarsal bones, then open operation should be considered."

I saw in consultation recently a case quite similar to Case IV of the above series. This patient's left foot was run over by a motor car. X-ray (Fig. 1) revealed comminuted fracture of the second, third and fourth metatarsal necks, with plantar displacement and shortening of the distal fragments also, fracture-luxation at the fifth metatarso-phalangeal joint, fracture of base of first metatarsal, and of outer sesamoid. It will be noted that the second toe rides between metatarsals two and three; the third toe rides on metatarsal four, while the fourth toe rides between metatarsals four and five, the fifth toe being displaced lateral to its metatarsal head. These displacements are practically identical with those in Case IV and are what one would expect, given a vulnerating force acting from the lateral to the mesial border of the foot and compressing the arched metatarsals proximally and the flat toes distally. The following then must be the mechanism of reduction in these cases. With both thumbs applied to the plantar surface just behind the displaced metatarsal heads, the latter are shoved vigorously forward and inward, an assistant at the same time exerting traction upon the toes in the same directions. Then, while the assistant maintains his hold on the toes, the metatarsal shafts are spread by plantar manipulations aided by dorsal pressure. This mechanism is one by which the deformity is virtually "untwisted."

Accordingly, under nitrous-oxide-ether, with the assistance of Dr. S. R. Skillern, Jr., this plan was carried out, with the result shown in the skiagram (Fig. 2)—again similar to that of Case IV of the above series, but in which the open method was employed.

I therefore submit this method as the one of choice, especially in those cases—as in mine—where there are constitutional contra-indications to open operation.

Respectfully yours,

P. G. SKILLERN, JR.



Fig. 1. Fracture of metatarsal necks before manual reduction.



Fig. 2. Fracture of metatarsal necks after manual reduction.

BOOK REVIEWS

EPHRAIM McDOWELL, FATHER OF OVARIOTOMY AND FOUNDER OF ABDOMINAL SURGERY. With an Appendix on JANE TODD CRAWFORD. BY AUGUST SCHACHNER, M.D. Cloth, 8vo., p. 331. Philadelphia, J. B. Lippincott Co., 1921.

Here is a book with a mission which the author has approached with all the zeal of an enthusiast and all the enthusiasm of a zealot. Fortunate is the man whose memory finds such a recorder to preserve it. Perhaps the most interesting and not the least important pages of this volume are those which present the attitude of the leaders in surgery in McDowell's time and for a generation thereafter, toward surgical attacks upon ovarian tumors. The reaction of the two Hunters to the problem is significant of all. In 1757 William wrote that he had seen a great number of encysted dropsies of the ovary and yet had never seen one cured. From his observations both in the living and the dead body he pronounced the disease to be incurable and expressed the opinion that a patient thus afflicted could have the best chance of living longest who does the least to get rid of it! His brother John, however, went a step farther in 1785 when he said that "he could not see any reason why, when the disease could be ascertained in an early stage, surgeons should not make an opening into the abdomen and extract the cyst. The merely making an opening into the abdomen is not highly dangerous." But, the more's the pity, John Hunter never did this reasonable and, in his opinion, not highly dangerous thing, notwithstanding according to the testimony of his brother the cases demanding it were to be seen in great numbers around him.

The possibilities of such operations remained an academic question until subjected to the test of an experiment made by a thoughtful, resourceful, self-reliant man in a frontier town of an American settlement!

The French School of Surgery, then the most dominant surgical influence in Europe, was even more positive in denouncing any intraperitoneal efforts than was that of Great Britain, and it was not until fifty years after the great and successful experiment of McDowell that the surgeons of Paris were willing to admit an ovariectomy to be a justifiable operation.

McDowell had undoubtedly become familiar with the academic side of the ovarian tumor question during his Edinburgh years. We can imagine his mental processes as he listened to the discussions of the subject by John Bell, and his quiet firm resolution that after he got back to his own land no case of the kind would be turned away from his door without the offer from him to make trial of the only possible means of relief. So when in December, 1809, Mrs. Crawford rode up to that door, he was ready for the experiment. But what shall be said of the woman? Her surgeon to raise her courage and hope, could not point to any record of successful attempts in similar cases either by others or by himself. He could but inform her of her dangerous situation and propose to her a procedure for her possible help which he was willing to make but which he had to confess was purely an experiment. The courage,

fortitude and determination of the woman was equal to the test. Success crowned the effort—not only were many years added to her own life, but she had been the means of demonstrating to an incredulous world the possibility of help to a fatal condition hitherto considered incurable. She was the first of an endless procession of women in whom hopeless suffering was to be relieved and to whom countless years of active life were to be added. The fullness of time for the advent of this ray of light to womankind had indeed come. It was Mrs. Crawford's happy lot to be the blessed agent of this new boon to humanity. All things conspired to make the experiment a success. Had it been otherwise we probably should never have heard of McDowell. As it was the operator, encouraged by the successful issue of the experiment, but not unduly elated by it, proceeded in after years to repeat his work in other cases and so remove it from the domain of experiment to that of demonstrated fact. After the completion of the third case with in all an equally happy issue, he made public his experience in 1817, by a contribution to the *Eclectic Repertory*, vol. vii, page 242, of Philadelphia, and by a memoir sent to his old Edinburgh teacher John Bell. In a letter written in 1829 about one year before his death, he says that in addition to his first case he had up to that time operated eleven times, with one death. Thus it must be admitted that McDowell's work was neither accidental nor sporadic. It was a thoroughly thought out, well matured procedure without precedent, but yet not without reason. It was the first intentional, systematic invasion of the peritoneal cavity to gain access to and to remove a diseased organ. There was nothing pyrotechnical about McDowell. He was modest, unassuming, thorough, but self-reliant and positive, quick to let action wait upon conviction. He was in a high degree the special product of ancestry and environment. The coming generations cannot do him too much honor, and among womankind especially should his name be revered.

In this delightful book of Schachner's, from every possible viewpoint the career of McDowell is presented with much fullness. The author has produced more than biographies of the two great actors in this drama of the first ovariectomy. He has given us a critical study of the man and his time.

He has also greatly added to our knowledge of the other actor in this drama, Mrs. Crawford; tracing her to the date of her death at the age of 78 years, and her burial in a remote and obscure cemetery in Indiana.

True to the genuine spirit of his own State, he has not failed to magnify the peculiar position which Kentucky occupied in the early advance of the frontier of civilization beyond the Atlantic seaboard and to give a clear outline of the special influences, molding character, in which the hero of his worship grew up.

We thank Schachner for this work. It is evident that great labor and time and expense have been given to its compilation, with the result of the production of a book of the greatest historical value.

LEWIS S. PILCHER.

THE SURGICAL EXPOSURE OF THE DEEP-SEATED BLOOD VESSELS. BY J. FIOLE, M.D., and J. DELMAS, M.D. Translated and edited by CHARLES GREENE CUMSTON, M.D., 8vo. cloth, p. 87. London, William Heineman, 1921.

This work is devoted to the description of procedures for freely exposing injured blood-vessels, in order that the pathologic conditions existing may be clearly seen and properly dealt with. These procedures have been suggested by war conditions and belong more especially to the domain of Military Surgery. The authors admit that the ligation of arteries in healthy tissues should still be carried out through the limited incisions that have become classic and are commonly described in all text-books of Operative Surgery. The case is altogether different, however, when the surgeon has to do with an injured vessel complicating a gunshot wound, when a diffuse hæmatoma or a focus of lacerated and disorganized tissue is the area in which a vessel is to be sought for; its damaged walls are to be recognized, and as much of it as possible to be saved in order not to unnecessarily compromise the vitality of the tissues which depend upon it for their vascular supply. A full and abundant exposure of the whole region involved alone can satisfy the requirements of such cases. Perfect and constant visual control over the field of operation is essential for safe and good work.

As one reads this plea for a change in methods of surgical effort in vascular surgery, one realizes that it is quite in harmony with the tendency of all surgery at the present time to abandon blind methods; to uncover every lesion by generous and free superficial incisions. The more deeply seated the condition to be dealt with, the more liberal the approach to be provided so that adequate exposure be secured for the performance of safe and certain surgery.

The recommendations of this book therefore are perfectly consistent with the best general surgery. The larger vessels of the limbs and of the neck are in succession dealt with. The illustrations are well designed. The descriptions are concise and clear. The translator has done his work well.

LEWIS S. PILCHER.

MODERN ITALIAN SURGERY AND OLD UNIVERSITIES OF ITALY. By PAOLO DE VECCHI, M.D. 8vo. Cloth; pages 249, illustrated. New York, Paul B. Hoeber, 1921.

This is an attractive book which cannot fail to command the interest of every surgeon whose horizon extends beyond his own parish. The modern surgeon has been as a matter of course thoroughly acquainted with the work of the Germans and the French and the English. The author with pardonable national pride is of the opinion that Italy has been sadly neglected and her share in the world's efforts toward further advancement in every branch of study, has not been recognized if indeed it has not been almost ignored. He calls attention to the fact that the recent World War has not only been a revelation of a new Italy to many foreign nations but has been a revelation

to herself. Italians of different provinces, heretofore unknown to each other, have been brought together to their mutual advantage and a better appreciation of the scientific value of the work done by their own countrymen. The object of the author therefore in this book is to familiarize American surgeons with the Italian School of Surgery; prompting them to visit Italy not only as a pleasure resort or a centre of antiquities but as a new seat of education.

The book opens with a rapid sketch of the creation of modern Italy, then takes up various phases of different military surgery in Italy, and then goes on more in detail to speak of the work and progress of the surgeons to be found at the present day in the various university centres of the country. The book is well worth the attention of every surgeon who desires to keep familiar with surgery's progress everywhere.

LEWIS S. PILCHER.

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THE RELATIONSHIP OF MASSAGE TO METASTASIS IN MALIGNANT TUMORS*

BY LEILA CHARLTON KNOX, M.D.

OF NEW YORK, N. Y.

CLINICAL

ONE of the most important aspects of the practical study of tumors is the determination of the anatomical and biological conditions which facilitate or prevent metastases. These phenomena have long been studied in man without much definite information having been collected. About all we know is that, in general, carcinomata are prone to metastasize through the lymph-channels and sarcomata through the blood-vessels, and that metastases do not always follow in the direction of flow of the current, but in a certain proportion of instances the emboli travel by a retrograde course or the tumors progress by direct extension, the so-called permeation of the lymphatics.

It has been generally assumed, without direct experimental proof, that a number of the factors favoring the production of metastasis are purely physical, for instance, the size and connective-tissue relations of the tumor cells, the pulsating or contractile movements of the organs in which they are implanted, the number of the blood-vessels and the thickness of their walls, with consequent susceptibility to trauma by pressure or massage. On the other hand, accurate clinical study and experimental work as well have caused the occult and convenient theories of tissue predispositions and specific "immunity" of organs to assume a less creditable position than they formerly held, and quite properly, for until it is shown that simple mechanical and biological facts do not account for the peculiarities in the occurrence and distribution of metastases vague theories should not be substituted.

The importance of vascular embolism in the spread of tumors has long held an unchallenged position in instances in which the pulmonary veins were known to be grossly involved and the arterial circulation in that way obviously open to a supply of tumor cells. A valuable contribution on this phase of the subject was made when M. B. Schmidt showed that not infrequently the tumor cells readily pass the pulmonary capillaries and are deposited elsewhere before macroscopic growth appears in the lung. In a study of forty-one cases of primary abdominal carcinomata without extensive gross

*From Columbia University, Institute of Cancer Research, F. C. Wood, M.D., Director, New York.

metastases, the lungs of fifteen were found to contain microscopic arterial emboli of tumor cells, showing that once the cells gain entrance to the blood stream they may reach any portion of the body and are not necessarily always retained or destroyed within the lungs. This may, however, be their fate, for Schmidt found many small thrombosed vessels with degenerating tumor cells entangled in the clot. These phenomena have been duplicated experimentally by Takahashi and by Iwasaki, both of whom injected tumor cells into the blood stream of animals. Both these authors have well shown that although embolic cells are frequently treated as foreign bodies and phagocytized, many, on the contrary, survive the adverse conditions, and invade and replace the vascular endothelium or undergo mitosis even before they become implanted on the vessel wall.

For purely physical reasons, however, we must suppose that cells of small size accomplish this more readily than do larger ones, and experience shows that the large spindle and giant cells, or those distended with mucus as many from the gastro-intestinal tumors are, do not find their way through the pulmonary capillaries except in small numbers. Whether or not the ameboid motion of the cells is a factor in facilitating this is not known. That such motion exists was shown by Carmalt in 1872 and later by Lambert and Haynes.

The localization and growth of embolic tumor cells within the dilated capillaries of the bone-marrow have been explained as due to the physiological hyperæmia which is practically constant in that situation. Slowing of the blood current and adhesion of the tumor cells to the endothelium seems to produce circumstances favorable to the growth of such emboli.

Lymphatic embolism, either direct or retrograde, has also been unquestionably a frequent and important means of tumor dissemination; but the status of lymphatic permeation, although very convincingly demonstrated by Handley in certain cases, is perhaps a less constant phenomenon than he at first believed.

The process, as Handley described it, consists in the proliferation of tumor cells which, having gained access to the superficial lymphatics in the proximity of the tumor, continue to grow within them and to extend through their branches, often appearing in the skin, where they form cutaneous nodules. Secondly, there often occurs an inflammatory fibrosis and obliteration of portions of the lymph-channel, a process analogous to the thrombosis which is common in invaded vascular channels. Handley studied especially breast carcinomata and melanomata—two of the tumors which most frequently exhibit regional cutaneous recurrences and extensions; and it is on the basis of his evidence that one may perhaps regard some of the recurrences in surgical scars as accidental occurrences due to the proliferation of tumor cells present in the lymphatics prior to the incision, though possibly accelerated in growth by the increased vascularity of the wound area. Probably, however, a majority of the local recurrences are due to a mechanical transplantation from an infected to a non-infected field.

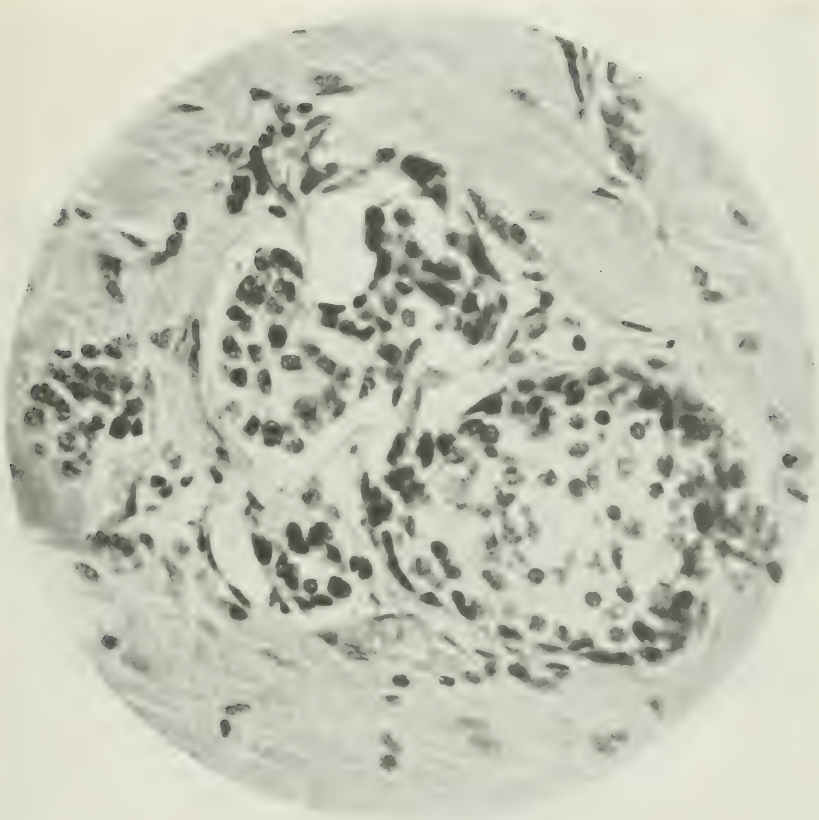


FIG. 1.—Metastasis of breast carcinoma in pectoralis muscle following massage in man.

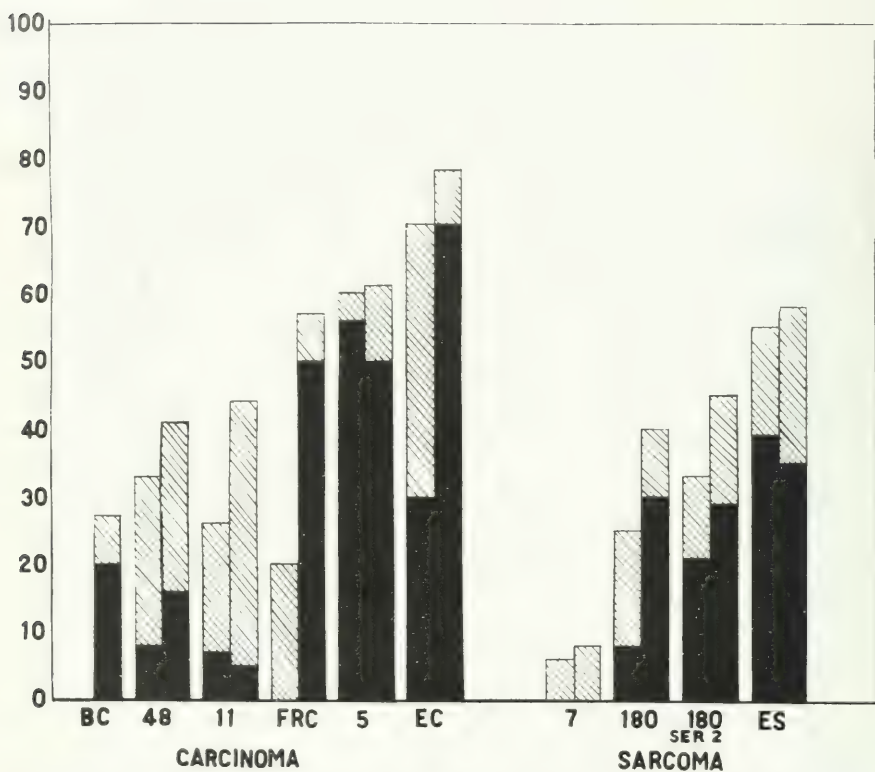


FIG. 2.—Chart showing percentage of emboli (hatched areas) and of metastases (solid areas), and their relative numbers in controls and massaged animals. In each case the column at the right represents the massaged animals, that at the left, the controls.

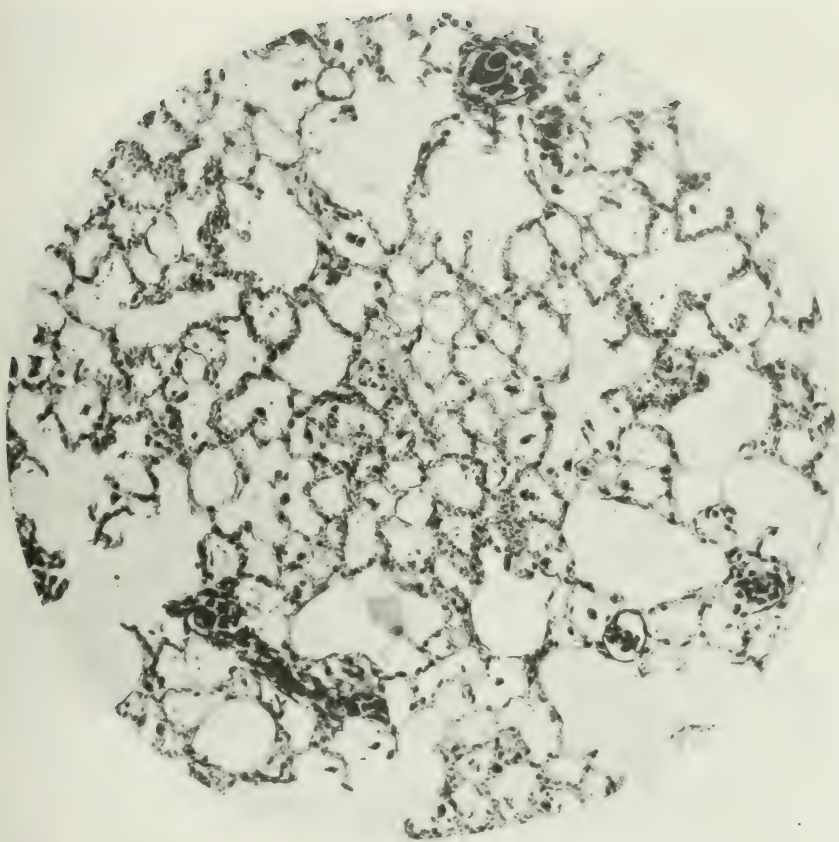


FIG. 3.—Multiple emboli of tumor cells in pulmonary vessels of a massaged mouse tumor.

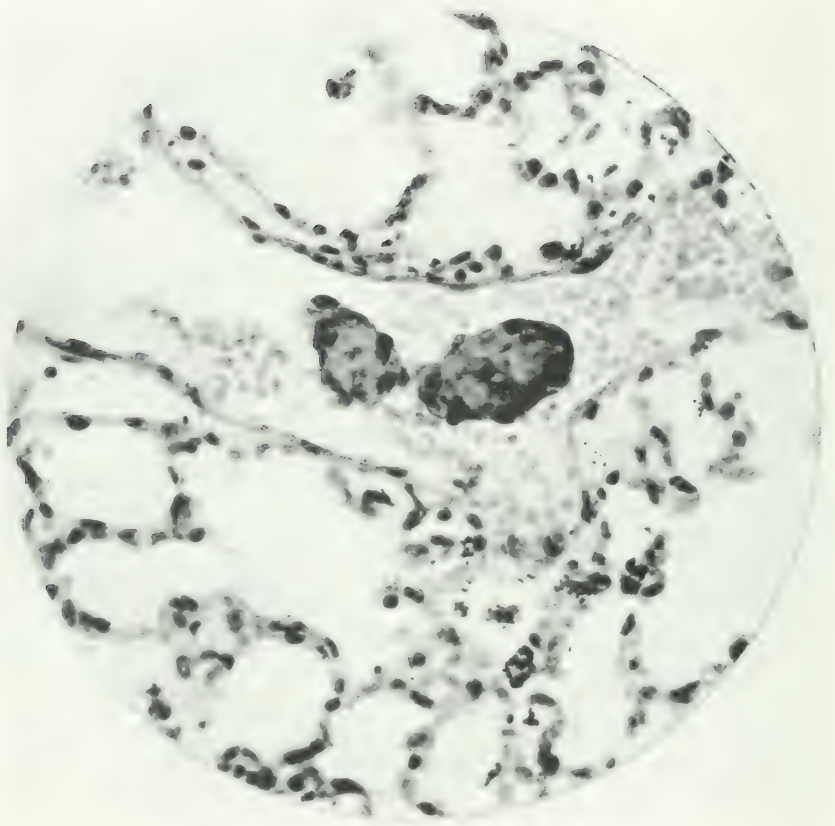


FIG. 4.—Degenerative changes in cells of a tumor embolus in pulmonary vessels.

In the case of the melanomata this mechanical transfer by operation is not a completely adequate explanation, for the nodules are often found far from the region of the incision, and, indeed, are frequently seen in unoperated cases, giving a striking illustration of the fact that tumor cells, especially those of moderate size, have the capacity to invade the cutaneous lymphatics for long distances and to spread against the direction of flow of the lymph. When the vessel is large, as in the abdominal trunks, permeation would not be expected to occur, and it is probable that extensive backward spread of tumor cells is due to a combination of several processes. Vogel has described two such cases, one a carcinoma of the gall-bladder, which extended into the left kidney hilus and there perfectly outlined the perivascular lymphatics of that region; the other a pancreatic carcinoma which extended directly along the mesenteric and aortic trunks into these nodes.

It is well known also that cesophageal carcinomata are prone to spread longitudinally along the lymphatics of the submucosa and that small secondary nodules often appear considerably below and separated from the oldest portion of the tumor by uninvolved mucosa. It used to be the fashion to describe these as implantation growths, but this view is now generally abandoned. Zahn has even described one situated as high as the tracheal bifurcation, but associated with three small carcinomatous nodules beneath the mucosa on the gastric side of the cardia. This occurred also in an cesophageal carcinoma with tracheal fistula (St. Luke's Hospital, No. 1309), the secondary nodule being 4 cm. from the main mass of the neoplasm. The mechanism of the formation of these multiple nodules, as well as of multiple papillary gastric carcinomata, has not been shown to be necessarily a process of permeation, although theoretically this would readily explain their occurrence.

On the other hand, emboli are, no doubt, prevented from growing by the mechanical activity of muscles and muscular organs. Metastases are singularly rare in the cardiac muscle, being practically never seen except in the case of extremely vascular tumors with scanty stroma from which the loosened cells spread and overwhelm the whole arterial circulation with countless emboli. The aortic valves must also act to deflect emboli from the mouths of the coronary arteries. Benecke, studying the invasion of the walls of vessels from carcinomatous thrombi, believed that the infrequency of metastasis in the muscular coat was due to the physiological tonus of the muscle. This is a reasonable conclusion, and the principle holds good for striated muscle as well. Metastases into the latter are extremely rare, due in part to the contractility of the fibres, a condition which offers considerable resistance. The fact that lymphatics are lacking within striated muscle bundles is certainly not the reason for the rarity of metastases, for if the emboli were lymphatic, not vascular, and if the motion did not play so large a part in preventing their growth, they should be present in tendons where lymphatics are very numerous. Direct permeation of both striated and unstriated

muscle is, however, frequently seen, showing that the soil is not unsuitable provided the cells once gain access to the tissue.

Normal peritoneum has been shown by Jones and Rous to possess a high resistance to the implantation of tumor cells, but when it was injured by a mechanical irritant, tumor growth was at once made possible. This offers an explanation for the frequently observed fact that carcinoma of the stomach often metastasizes into the ovary, producing the so-called Krukenberg tumor of the latter organ, without any intermediary deposits on the peritoneal surface. That such deposits will eventually occur in late stages of carcinomatosis is, of course, well known, but it is probable that the constant motion of the opposed serous surfaces is an important factor in destroying whatever cells may find their way to it. It has long been recognized that it is the gelatinous carcinomata of the ovary, stomach, and intestine that are most widely distributed in the abdominal cavity. This is, of course, as would be expected, for the bulk and consistency of the mucus make it in a sense a foreign body and must keep the cells in contact with the peritoneum and also irritate it, and so indirectly facilitate adhesion and ultimate vascularization, whereas a few free cells would be more likely to be destroyed.

Post-operative human results have occasionally shown the remarkable persistence which cells from malignant tumors may exhibit. During the quiescent period the cells are probably most frequently inactive in the lymph-nodes, occasionally for as long as ten to twenty years. Late recurrences usually appear first in the nodes to which drainage was directed, and if the morphology of the tumor is that of the primary growth there can be no question that these are really late recurrences from previous metastatically deposited cells. For example, small groups of living cells from a gastric carcinoma have been observed by Rohdenburg in the liver and omentum ten years after the operation on the primary tumor, with a clinical cure. Such a case may be the result, like many of the very late cutaneous recurrences from breast tumors, of slow permeation along the efferents of a node or even from a small group of cells for years quiescent in the tissue spaces.

A spindle-cell sarcoma has occasionally recurred after a very long period. A tumor of this type, originating in the cervical fascia, has been seen by the writer recurring as a mass the size of a walnut twelve years after the first operation, the patient being free from symptoms during the greater part of the period. Such a phenomenon is difficult to explain, since only rarely does this type of sarcoma metastasize into the lymphnodes, and there form a focus for new growth. As this recurrence was in the centre of a large skin graft made at the first operation, it seems more probable that it was a recurrence *in situ* of very slowly growing cells situated in the deep fascia below the graft.

Other rare and late metastases which give no hint as to the mechanism of their localization and long course are cited by Schmidt and Goldmann, who observed a cerebral metastasis four years after a rectal carcinoma with no local or lymphatic return. Schmidt believes that such tumors are derived

MASSAGE METASTASIS

from latent intravascular cell groups in the pulmonary vessels. Another still more remarkable observation is that of Crouzon, who described a cerebral metastasis eighteen to twenty years after operation on a bilateral breast carcinoma. Gathmann and Schmidt have each observed cases in which four years after operation on similar tumors, with apparent cure, widespread skeletal metastases appeared. In such a case a general emboli distribution of cells by the blood into the capillaries of the myeloid canals must have occurred fairly early, and the growth processes have been very slow.

The frequency of skeletal metastases is so much greater than can possibly be demonstrated by clinical or röntgenological means until a very

TABLE I
Carcinomata

	Number animals	Number of animals with met- astatic tumors	Number emboli	Total no. animals with met- astatic particles	Per cent metastases	Per cent emboli	Total % metastatic particles	Difference of % in met- astases in controls and massaged animals
<i>F. R. C.</i>								
Controls.....	15	3	0	3	20	0	20	
Massaged.....	14	7	1	8	50	7	57	37
<i>B. C.</i>								
Controls.....	5	0	0	0	0	0	0	
Massaged.....	15	3	1	4	20	7	27	27
<i>E. C.</i>								
Controls.....	10	3	4	7	30	40	70	
Massaged.....	13	9	1	10	70	8	78	8
<i>No. 5.</i>								
Controls.....	23	13	1	14	56	4	60	
Massaged.....	18	9	2	11	50	11	61	1
<i>No. 11, series I.</i>								
Controls.....	26	2	5	7	7	19	26	
Massaged.....	18	1	7	8	5	39	44	18
<i>No. 11, series II.</i>								
Controls.....	15	3	1	4	20	7	27	
Massaged.....	21	4	2	6	19	9	28	1
<i>No. 48.</i>								
Controls.....	12	1	3	4	8	25	33	
Massaged.....	12	2	1	3	16	25	41	8

advanced stage that the high percentage of such growths is not often appreciated. Although the vascularity of the marrow is great, the stroma reaction may be here as marked as elsewhere and the metastasis of a scirrhus breast carcinoma be only a sclerotic nodule of the same appearance as the primary growth. When the bones are noticeably eroded or spontaneous fractures occur the process is far advanced and statistics drawn from such cases only give misleading data as to the frequency of the process.

This view of the localization of metastases has not, however, been universally accepted, and many convenient hypotheses have had to give way to the increasing weight of pathological and experimental evidence. The theory of the specific adaptation of some tissues, as the liver, for neoplastic cells, and the relative immunity of others, as the brain, has been prevalent in

the literature for many years. Virchow stated that organs in which carcinoma is never primary do not serve as a site for metastases. Recent observation has shown these conclusions to be wholly incorrect, as the brain is the site of secondary metastatic carcinomatous deposits in at least 0.3 per cent. of all autopsies (Krasting). Adherents to this theory point out, however, that some types of tumors have distinctly greater capacity to metastasize into certain organs than others, since not all tumor cells readily grow within the bones, but others very commonly do so, as those of the breast, thyroid, adrenal and ovary. Von Recklinghausen even advanced the idea that breast and prostatic carcinomata were apt to form metastases in similar regions because they were in a sense analogous organs, each being a part of the genital system. Bamberger and Paltauf believed that there was some specific organ susceptibility, and offer as evidence the fact that not only the small-cell carcinomata of the prostate metastasized to the bones, but the large-cell medullary carcinomata of the gland behaved in the same way.

The spleen also has been called "immune" to metastases by various writers because gross tumors in it are not especially frequent and microscopic ones often escape detection; but late stages of breast carcinoma are not infrequently accompanied by palpable enlargement of that organ due to a diffuse carcinomatosis, while E. E. Goldmann demonstrated that animal tumors inoculated into the spleen grow as readily there as elsewhere. While the vascularity of the organ exposes it to numerous emboli, yet as it possesses no efferent lymphatics and is in practically constant motion, embolic cells can not proliferate within it with as much facility as in some other organs. The great vascularity of the adrenals, as well as their protected position and absence of intrinsic motion, provides a suitable location for the secondary growths so often found in them. It is possible that the wide vascular sinuses of the pituitary, which resemble those in the adrenal, facilitate the location of metastatic tumors in this organ as well.

External mechanical influences have for some years been recognized as an important factor in dealing with any malignant tumor. Gerster, in 1885, discussed the apparent breakdown of the forces which keep a malignant tumor for a time localized, and believed them to be largely mechanical. He pointed out the need, for example, of high amputation, not alone for the purpose of obtaining an uninfected field, but in order that the neoplasm itself should be free from manipulations, and so facilitate cellular dissemination. This writer further compared the results of malignant tumor massage to that which is sometimes effected by massaging a sprained joint—a process which certainly disseminates inflammatory exudate rapidly and widely. The effect of pressure, rubbing, or active massage on the tumor has been frequently observed in human beings as the result of osteopathic or massage treatment of malignant tumors, and many examples have been seen in recent years of wide dissemination of a primary growth very effectively accomplished by this procedure.

Such an instance has recently occurred at St. Luke's Hospital, and fur-



FIG. 5.—Embolus of tumor cells in pulmonary vessel. Embolic cells are undergoing early degenerative changes. The lung tissue is well preserved.

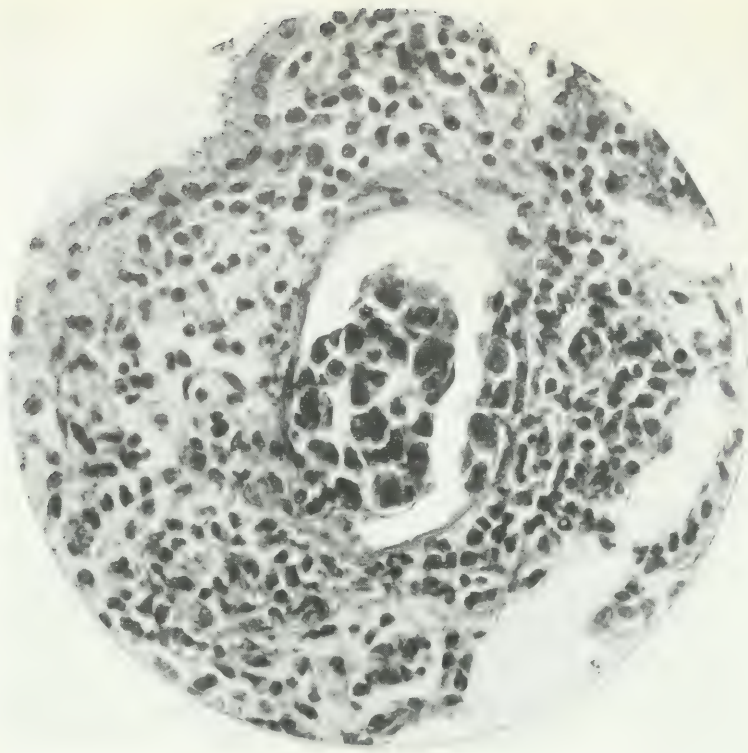


FIG. 7. Later stage in implantation of embryo tumor cells. A few have replaced the endometrium.

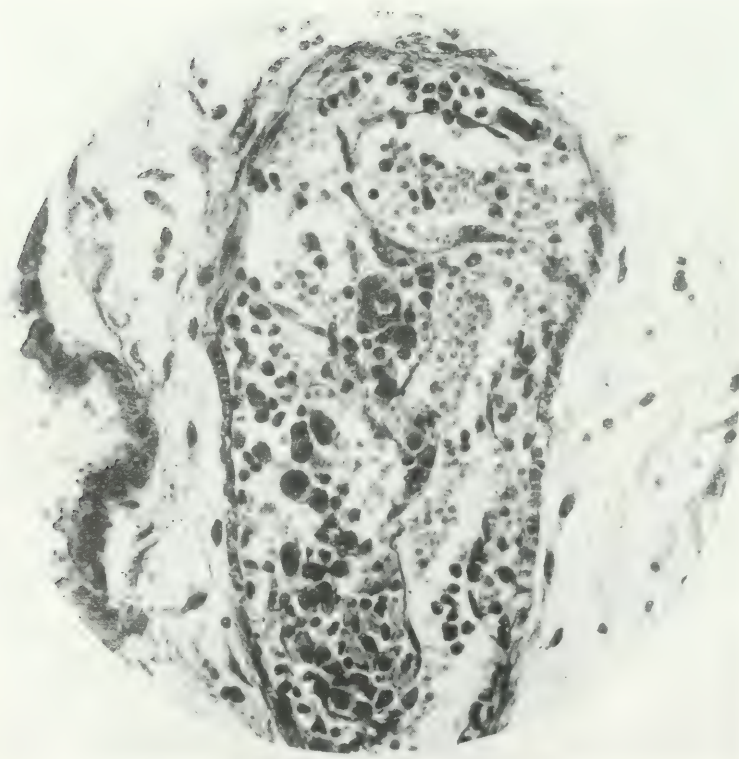


FIG. 6. Endothelium of vessel containing embryo tumor cells stripped from wall. Early stage of attempt to localize.



FIG. 8.—Small nodule from case of carcinoma of stomach in man, showing invasion of pulmonary vessels. Nuclei surround a central mass of tumor.

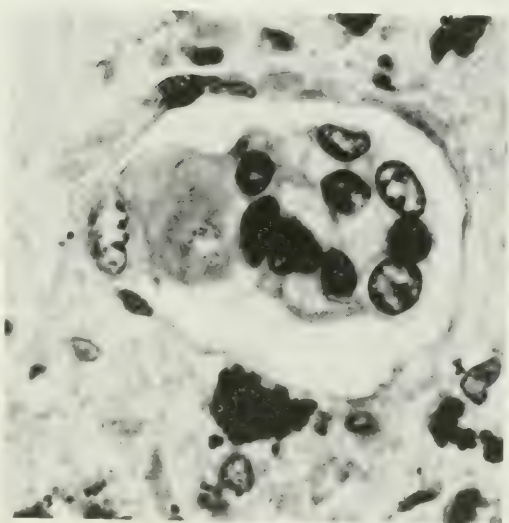


FIG. 9.—Beginning adhesion of tumor cells to endothelium in pulmonary capillary from case of carcinoma of stomach in man.

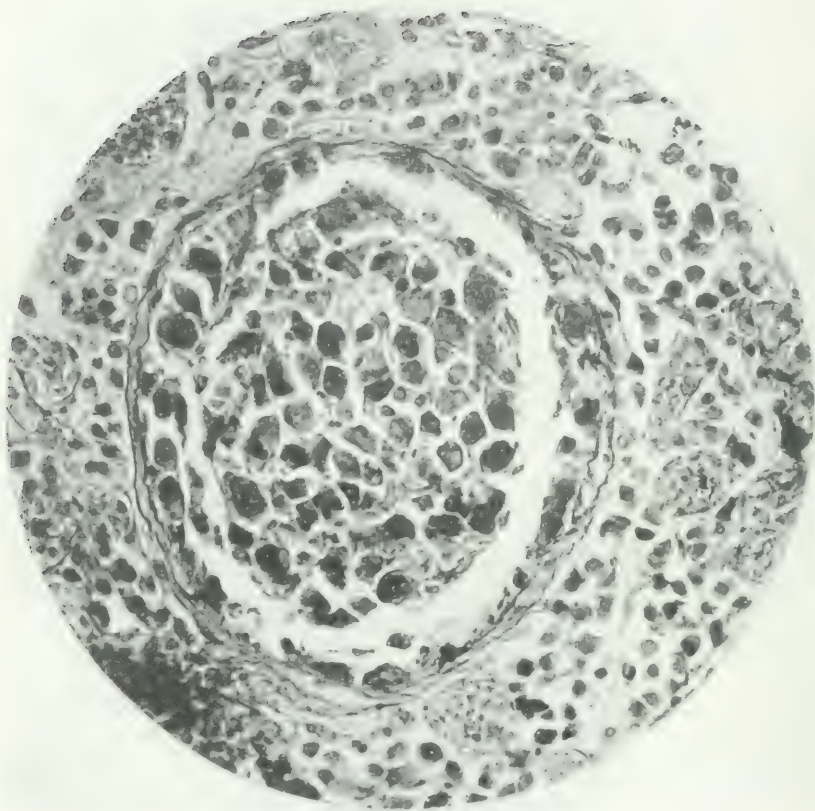


FIG. 10.—Embolic tumor cells replacing endothelium of pulmonary vessel.

nishes one of the rare instances in which extensive gross metastatic invasion of muscle could be observed. The patient stated that massage treatment had been regularly employed for some time previous to admission. When the breast tumor was examined there was found a fairly extensive area of eczema overlying a large very hard tumor which was fixed to the pectoralis fascia. Small white tumor nodules were scattered widely throughout the muscles, even invading the individual fibres. (See Fig. 1.)

EXPERIMENTAL

While, therefore, much interesting and important information has thus been obtained by clinical, operative, and post-mortem studies, the number of cases is too small to enable final conclusions to be drawn.

The determination of the weight of a factor in producing metastases can not be judged from single experiences on man, as it is impossible to eliminate conflicting conditions. Only by the use of a homogeneous material in which the size of the cells, their histological and biological qualities, and the vascularity of the surrounding tissue, etc., are practically constant can valid conclusions be drawn, and this elimination of variables is possible to obtain only by the use of animal tumors of a long transplanted strain, so that the morphological and biological characters are well known. The possibility of obtaining by inoculation in a single day more tumors than any one surgeon observes in a lifetime of active practice also eliminates the occurrence of errors due to random sampling affecting the result—a condition never possible in human material. For example, following the discussion produced by the publication from the Crocker Fund of a paper on the results of the incision of tumors, many surgeons brought forward individual instances which they thought were of value in proving the danger of diagnostic incision, not realizing that from a statistical aspect a single instance is of no value. Even from a basis of reasoning, so remote from the complexities of mathematics as what is ordinarily termed common sense, many of those who cited these single instances were unable to deny on cross examination that pre-operative manipulation by the patient, or that dragging or pressure on the tumor during the operation might have equally well caused the evident dispersal of tumor particles, as evinced by the subsequent course of events.

It was not until Tyzzer, in 1913, demonstrated that gentle massage of a transplanted carcinoma in a mouse greatly increased the number of metastases observed in the lung that definite evidence was brought forward to substantiate these occasional clinical observations. The number of Tyzzer's experiments was small, and he obtained results with only one tumor, a highly malignant neoplasm of the Japanese waltzing mouse. With the Ehrlich mouse tumor No. 11 and the Jensen rat sarcoma he was unable to obtain metastases artificially by massage of the implanted tumors. Rous states that his experiments in massaging rats with adenocarcinoma resulted in the death of all the animals, but did not cause more than the ordinary number of metastases.

Several recent clinical experiences of the writer in which after the removal of a very small primary tumor of the breast by perfect surgical technic (no involvement of the axillary nodes being present), the patient died of generalized carcinoma in a short period thereafter, pointed to the desirability of further extension of Tyzzer's experimental results. We will say, in passing, that in one of these human tumors which had been somewhat vigorously palpated by a number of physicians, a small hemorrhagic area was found in the middle of the growth, and in the vessels surrounding the tumor numerous emboli of cancer cells were present.

TABLE II
Sarcomata

	Number animals	Number of animals with met- astatic tumors	Number emboli	Total no. animals with met- astatic particles	Per cent metastases	Per cent emboli	Total % metastatic particles	Difference in % of me- tastases in controls and massaged animals
No. 7.....								
Controls.....	16	0	1	1	0	6	6	
Massaged.....	12	0	1	1	0	8	8	2
Ehrlich sarcoma..								
Controls.....	31	12	5	17	39	16	55	
Massaged.....	26	9	6	15	35	23	58	3
No. 180, series I..								
Controls.....	12	1	2	3	8	17	25	
Massaged.....	10	3	1	4	30	10	40	15
No. 180, series II								
Controls.....	73	16	9	25	21	12	33	
Massaged.....	85	25	14	39	29	16	45	12

A considerable variety of transplantable carcinomata or sarcomata of the mouse and rat were used for the experiment. Some of these tumors under normal conditions, especially the spindle-cell sarcomata, do not produce spontaneous metastases in the animals in any number. Others, especially the carcinomata, are apt to metastasize early.

The following tumor strains were employed: Crocker Fund mouse carcinomata, Nos. 5, 11, and 48, the Borrel mouse carcinoma, the Ehrlich mouse carcinoma and the Flexner rat carcinoma; Crocker Fund mouse sarcomata Nos. 7 and 180, and the Ehrlich mouse sarcoma.

The method employed was as follows, with the exception of the two series described separately below: The animals were inoculated subcutaneously in the inguinal or axillary region with a tumor particle weighing about 0.003 gm. When the tumor reached a diameter of approximately 5 mm. it was gently massaged for half a minute every other day for about two weeks. The tumor was then removed by operation to prevent further metastasis, in order to obviate the difficulty of having to decide whether embolic masses in the vessels

of the lung were really growing tumor particles, or only recently deposited emboli which might ultimately die without giving rise to a tumor nodule. In the final results only those masses are considered as true metastases in which the vessel wall was invaded, a separate column giving the number of instances in which emboli were found in the lumen of the pulmonary vessels.

In one series, mouse carcinoma No. 11, the experiment was repeated, and the technic was varied as follows: The tumor was massaged vigorously for one minute on each of two consecutive days. After the second massage treatment all tumors, both controls and those which had been manipulated, were excised and the animals all killed twenty-seven days later. (No. 11, Series II.)

In order to check the results a third series of mice were inoculated two years after the first lot with the Crocker Fund mouse sarcoma No. 180. The mice were all of the same breed, and the conditions were kept as nearly as possible the same as in the preceding experiments. This time the mice were inoculated in the right axillary region, and as soon as the tumors were easily palpable the massage was begun on one-half of the mice, the others being reserved for controls. As before, the massage was carried out for thirty seconds on alternate days for about two weeks. The tumors were then very large, and many of the mice died at this time. In those surviving the tumors involved the thoracic wall too extensively to make removal feasible, so the animals were, therefore, allowed to die and then were autopsied. The results of this experiment are recorded as No. 180, Series II.

In all the series the lungs were carefully removed, distended through the trachea with 4 per cent. formaldehyde, and hardened, and six sections from each animal were examined. Much difficulty was experienced in determining microscopically whether a mass of cells in a vessel should be considered as a true metastasis or merely an embolus. When emboli cease to be capable of forming a tumor we do not know. Careful morphological studies have been made by Takihashi and others to determine the early degenerative and proliferative changes which occur in emboli of tumor cells, but the two processes are frequently coincident, and, as many groups showed no evidence of either process even after being in the vessels many days, we cannot be too cautious in deciding whether a death point has been reached. Such emboli were found, for example, in specimens 9515, 6363, 6359, thirty-two, twenty-seven, and twenty-six days after removal of the primary tumor and no local recurrence at the site of inoculation had taken place from which such emboli could have been derived. Presumably such cells are dead; hence these groups have been called emboli, not metastases. In one sense, however, they are just as important as a growing lung tumor in showing that emboli of cancer cells can be set free in the blood stream by massaging a tumor, and any embolus in its early stage carries the potentiality of metastasis formation.

Only six sections of the lungs were studied, for it was found after a few

complete sets of serial sections had been examined that the gain in number of emboli or small tumors discovered was unimportant.

The tabulated records of the experiments are self-explanatory and need no further elucidation.

DISCUSSION

Examination of the chart (Fig. 2) shows that, in general, with nine tumor strains, there was a more or less distinct increase after massage in the number of embolic particles in the lungs, the increase varying from 1 to 37 per cent. The actual percentages can be considered of little importance, and it is even surprising to find that the tendency is so general. With the carcinomata the results are in many cases unequivocal; for example, the Ehrlich carcinoma, at the time showing no regression and 75 per cent. of takes, in other words, in its positive phase, formed more than twice as many metastases after massage as without it. A similar condition obtained with the Borrel carcinoma, at that time spontaneously regressing in 50 per cent. of inoculations, but still showing numerous metastases after massage. The ratio is probably artificially high as the number of control animals which survived was very small.

The emboli are found in both lymph- and blood-vessels, frequently in both locations in the same lung. The perivascular space can frequently be seen filled with cells from which the parenchyma is invaded, but the primary process is evidently in the vessels, as it is seen in all stages within them. The lymphatic system of the mouse being developed to a much less extent than in man, it may also be expected to show relatively less tumor involvement. One reason for this may very probably be, as is pointed out by Murray, that the lymphatics are so delicate and quickly obscured by an inflammatory reaction that metastatic particles apparently freely growing in the tissues may have originated from an embolus either in a lymph-vessel or the nodal capsule. In these studies, however, there is seldom room for doubt that the emboli are vascular in the great majority of cases. Multiple emboli nearly filling both large and small vessels of a lobe are occasionally found in the controls as well as in the massaged animals, but cell groups are much more frequent in the treated ones. The illustration (Fig. 3) is from a massaged animal which died twenty-four days after inoculation. Both proliferation and degeneration are seen, and most of the stages described by Takahashi may be found in some area. Fig. 4 (No. 18363) and Fig. 5 (No. 18319) each show a small embolus which is certainly undergoing dissolution, as the surrounding lung is well preserved, but the tumor cells stain poorly. The outlines of cell walls and the nuclear membrane are indistinct, and the cytoplasm granular.

On the other hand, occasionally even small emboli may be seen in which the actively invasive tendency of the tumor cells is plainly demonstrated. Fig. 6 (No. 18322) shows a small embolus which has apparently lifted up the endothelium from the vessel wall and so given itself a fibrous surface upon which to obtain a footing. Another phase of apparently successful

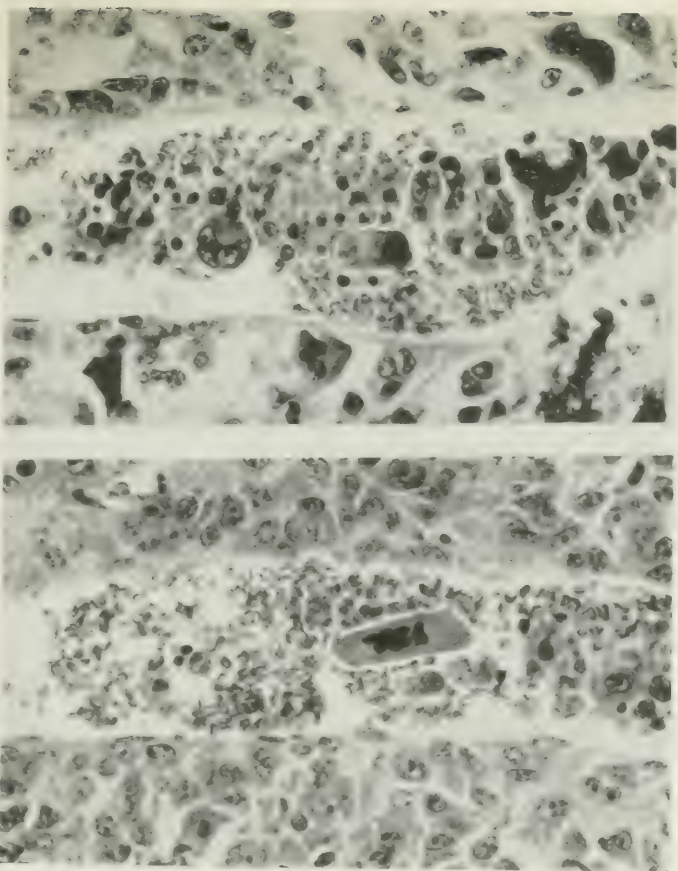


FIG. 11. (a) Endobulbs from bone sarcoma in man. Cells are of several types and illustrate early degenerative changes and phagocytosis. (b) Giant cell in blood vessel in bone sarcoma.

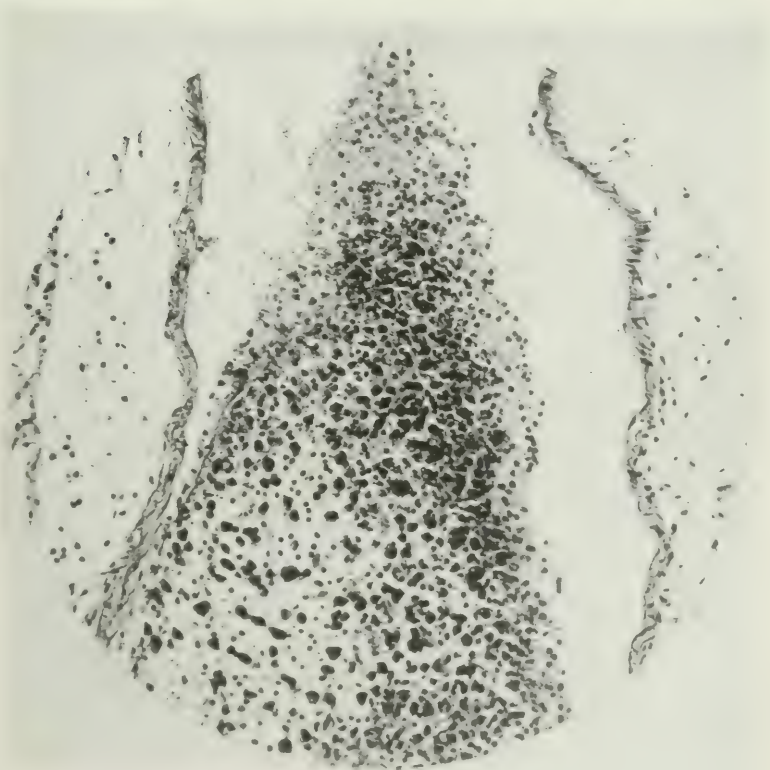


FIG. 12. Large tumor endobulbs in pulmonary artery.

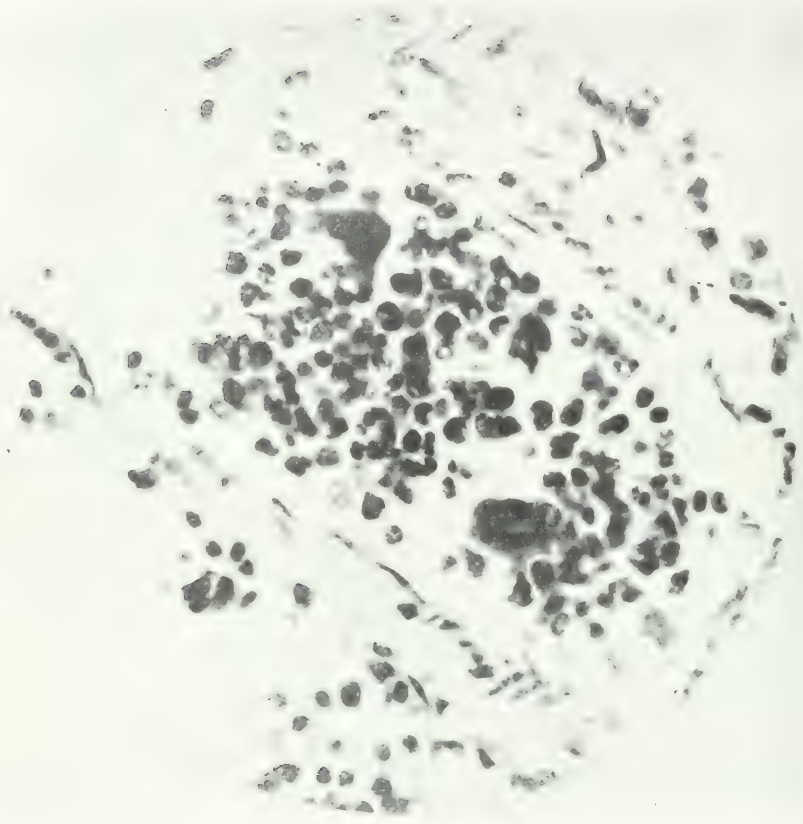


FIG. 13.—Polymorphonuclear cells surrounding a few embolic tumor cells; probably an early stage of thrombus formation.



Fig. 14. Large emboli of tumor cells in perivascular lymph space, probably an extension from a vascular thrombus.

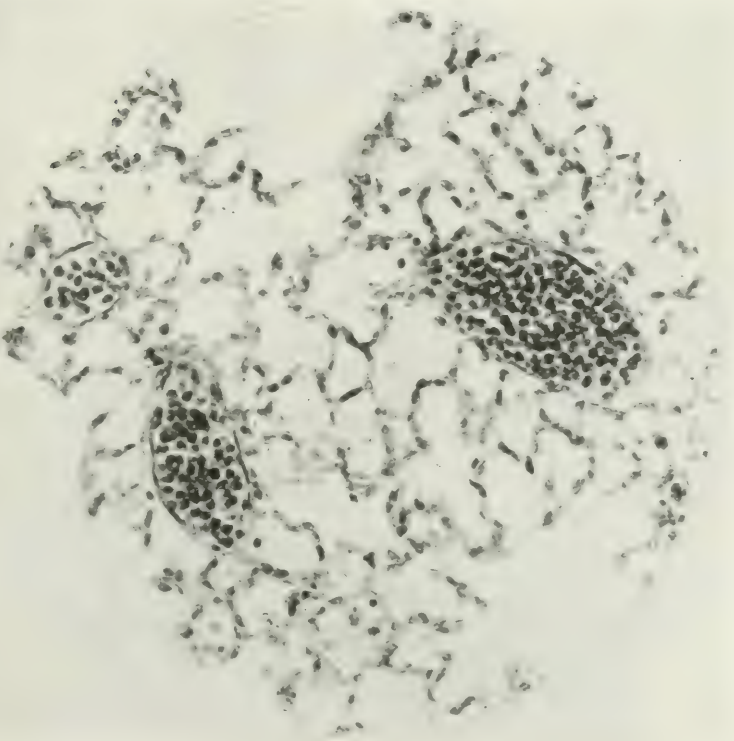


Fig. 15. Multiple emboli of small cells in pulmonary vessels, possibly tumor cells, but resembling lymphocytes.

implantation is shown in Fig. 7 (No. 18343), where a number of well preserved tumor cells are growing in direct continuity with the endothelium. Figs. 8 and 9 show two small pulmonary emboli from a case of carcinoma of the stomach in a human being. In Fig. 8 there is no adhesion of the embolus to the endothelium, although nearly a third of the mass is made up of mucus produced by the epithelial cells; in Fig. 9 one cell only appears to have invaded the endothelium. Another lung furnishes a picture of a more advanced stage of invasion, Fig. 10 (No. 18384). The endothelium can no longer be distinguished, as practically the whole circumference of the muscularis is lined with the tumor cells, and the lumen is almost filled with a carcinomatous embolus in which early degenerative or thrombotic changes have occurred. Similiar parietal thrombi were examined by Schiedat throughout their length and were found to extend for some distance along the surface of the wall and eventually to break through it. The same process is illustrated in Fig. 11 (a) where a large vascular sinus is shown containing many embolic cells from a bone sarcoma in man. The nuclei already show pyknosis, swelling, agglutination by fibrin, and are being surrounded by polymorphonuclear and lymphocytic cells. In (b) is another large blood-vessel from the same tumor with a giant cell among the red blood-cells. This, although of the "endothelial" type and not itself likely to invade other tissues, is of interest in showing that all types of cells may gain access to the blood stream.

That most of the small vascular emboli are derived from larger ones in the main vessel, and not from primary lymphatic involvement, is seen from such an extensive embolus as appears in Fig. 12 (No. 18343), a fairly frequent picture. A very large mass is found in one of the main pulmonary veins and many of its cells are degenerating, the nuclei are pyknotic, and some of the cells have been phagocyted. Figure 13 shows a smaller group of cells surrounded by a thrombotic mass containing many polymorphonuclears, as would be expected in such a situation. It may only occasionally be seen that the cells break into the lymphatics and there grow freely, but it is shown in Fig. 14 (No. 18307). Not infrequently, as in tissues from human beings with tumors, multiple emboli are found in the vessels which may be densely crowded with cells, most of them small, and though hyperchromatic only with difficulty to be distinguished from lymphocytes—in fact, to make a differential diagnosis is very hazardous in spite of the absence of inflammation elsewhere in the section (Fig. 15).

Inspection of Table III shows that among the controls metastases and emboli were coincident only four times in twenty-one animals, or in 19 per cent., while among the massaged this occurred nine times in twenty-five animals, or in 36 per cent. of the cases. The average duration of life was the same in each case. There seems little doubt but that the massage has effected a wider distribution of the tumor even though it is impossible to decide in all the cases just what the ultimate fate of the scattered cells may be, whether they will die or succeed in establishing themselves in the vessel wall.

On the whole, the polyhedral-cell sarcomata (Crocker Fund No. 180 and Ehrlich mouse sarcoma) seemed just as apt to produce metastases as the carcinomata. In the spindle-cell tumors, metastases are apt to be scanty. This may be explained upon mechanical grounds, from the fact that the cells of most fibro- or spindle-cell sarcomata are more definitely intermingled with and attached to the surrounding connective tissue than in the case of the free-living cells of the carcinomata. This sustains the view that anatomical relationships of the cells are important in determining metastases.

TABLE III
Crocker Fund No. 180

Mouse no.	Controls		Mouse no.	Massaged	
	Metastases	Emboli		Metastases	Emboli
18276	2	6	18296	1	
18289	2		18305		3
18300	1		18307	2	3
18302	1		18315		1
18308	1	1	18319	1	6
18321	2	1	18335	2	
18322		6	18370	3	3
18341	1		18372	2	2
18343		3	18373	3	3
18349	1	1	18380	3	3
18352	1		18383	2	2
18355	2		18384	2	6
18363		4	18390	3	
18404	1		18394	1	1
18423	2		18395	2	
18427	1		18399	2	
18433	1		18407	1	2
18480	3		18418	3	
18484		1			
18310	1		18426	3	
18374		1	18428		1
			18446	1	
			18405	2	
			18316	1	
			18323		2
			18334	1	

Total number metastases in controls = 23

Total number emboli in controls = 24

Total number metastases in massaged = 41

Total number emboli in massaged = 38

It would be incorrect, however, to assume that the mechanical factor is of so great importance in determining the ultimate production of a growing tumor as distinct from an embolus as the biological characteristics of the tumor itself. Examination of the chart shows that the correlation between the percentages of total metastases in controls and massaged animals is negative, that is, that those tumors which metastasize spontaneously in a high percentage do not show as great an increase after massage as do those in which spontaneous metastasis is low. For example, the Crocker Fund carcinoma No. 5 shows a smaller increase in its percentage of metastases than does the Flexner rat carcinoma. The same is true of the Ehrlich sarcoma, a strain

in which Haaland also found a high percentage of spontaneous metastases; in fact, this writer reports approximately the same percentage of metastases in the twenty-three mice which he observed (60 per cent.) as were seen in the twenty-six animals used in this experiment (58 per cent.).

In these freely metastasizing highly vascular tumors the organism is evidently flooded with emboli before manipulation, and hence many tumor cells may be found in the pulmonary capillaries at all times. Less difference, therefore, can be detected following the massage.

There can be no question under these circumstances that concomitant immunity has any influence on the prevention of appearance or growth of the metastases.

CONCLUSIONS

1. Study of human material in many ways suggests, but does not finally prove, the importance of massage as a means of inducing metastasis of tumor cells. In animals, on the contrary, very gentle massage for a total period of from two to five minutes, distributed over a number of days, has been shown to set free numerous particles of tumor which form emboli in the lungs.

2. Such emboli produce metastatic tumors in a variable proportion of instances, depending upon the growth activities of the tumor. Tumors which take in low percentages when implanted in the subcutaneous connective tissues give much fewer metastases than those of high virulence.

3. Carcinomata and also sarcomata of the loose polyhedral-cell type are easily generalized, but sarcomata of the compact spindle-cell variety are not influenced.

4. The importance of avoiding diagnostic or operative manipulation of a tumor in man is obvious.

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TREATMENT OF ERYSIPELAS WITH CHINOSOL AND SODIUM CHLORIDE

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A NUMBER of years ago, the writer determined in cases of erysipelas the presence of bacteria in the subcutaneous fat one inch in advance of the line of demarcation of the erythema, which were there found in greater abundance than in the subcutaneous fat either beneath the line of demarcation, or one inch behind the same. In two out of five cases, cultures taken from the subcutaneous fat at these three sites were all negative, and of the remaining three cases, in two, streptococci were found and in one, diplo bacilli.

Hence a principle in the treatment of erysipelas by topical applications can be laid down, that the area of skin treated should include a wide margin of the normal-appearing skin adjoining the line of demarcation, in order to try and destroy the bacteria which particularly are connected in the spread of the disease. In this work, the boundary of the area to be treated was established by a line about 3 or 4 inches beyond the line of advance of the erythema.

In the writer's earlier experience, erysipelas of the back has always been well-nigh impossible to control by topical applications, so that when a remedy is found, as here demonstrated, whose use has been followed by the arrest of erysipelas in this locality in a fair proportion of these cases, this remedy would seem to possess a distinct worth for the treatment of erysipelas.

The chinisol preparations employed were two in number, one an ointment and the other a tincture.

The formula for making the chinisol ointment is as follows:

R

Aquæ dest. (cold sterile), 3ss

Add and dissolve

Pulv. chinisol grs. x

Then add

Sod. chloride (reagent) grs. iv

Rub up, first with

Lanolin 3ss

Finally incorporating

Vaseline (white) 3ss

M. et Sig.—Chinisol ointment.

The Chinisol Ointment.—The chinisol ointment while applicable for use in the treatment of erysipelas affecting any skin area of the body was generally used for all parts of the body only in children, its use in adults being generally limited to the face and ears. The advantages of the ointment over the tincture in the facial cases were, that it could be applied more easily

to the irregularities of the face and ears and that it could be used on the eyelids without much danger of its getting into the eyes, the latter occurrence, though highly undesirable, being one of seeming minor significance in the case of the ointment.

NOTE.—The chinisol ointment is also of great value to abort beginning hair-follicle infections (rubbed gently in for two or three minutes and repeated, if necessary, in two or three hours). It is useful for healing abrasions, small, healthily granulating ulcers, chapped hands, insect bites (relieves the itching) and stings. A prior ointment containing chinisol, grs. vi, and sodium chloride, grs. ii, to half an ounce each of lanolin and vaseline, has been found healing for second degree burns, and it is thought that the present ointment would be equally efficacious and non-irritating for this purpose.

The formula until March 23, 1921, called for 5i of water as the solvent of the chinisol and sodium chloride in 5i of the ointment, but in order to stiffen the ointment and to cause a more ready taking up of the ingredients by the lanolin, the lesser amount of water (5ss) was substituted. The addition of sodium chloride to chinisol in aqueous solution produces in the evaporated specimen a crystallization different from that seen in an evaporated specimen of a solution of chinisol alone, the characteristic features of which are, the formation of radiating or diverging rods and, where there are open spaces, needle-like projections. This transformation in the crystallization of the chinisol has seemed in some way to be associated with a lessening of the irritative properties of chinisol. Thus, in days gone by, before sodium chloride was combined with chinisol, the largest amount of chinisol that could be used in the ointment without causing irritation, was grs. vi to the ounce, the use of an ointment containing grs. viii or grs. x to the ounce on a skin surface at that time, soon having caused excoriation of the cuticle. The present ointment, however, has caused not the slightest irritation when applied *per se* to normal or inflamed skin in the treatment of the erysipelas cases. Therefore in making up the ointment, it has seemed important to first combine the sodium chloride with the chinisol in a minimum amount of water, before these ingredients are incorporated into the lanolin, so as to fully establish at the outset the change which takes place in the chinisol as a result of thus combining it.

This ointment, however, if thin enough, may run into the eyes and cause therein a little burning sensation, and in two such instances (Cases Nos. 34 and 35) the ointment apparently was the cause of a vascular injection of the sclera. Also in an instance of marked swelling of the conjunctiva (Case No. 65) the ointment may have been the etiological factor. These eye irritations rapidly cleared up with the application of boric acid compresses. Hence the lanolin used should not have too thin a consistency.

The Tincture of Chinisol.—The tincture of chinisol was found serviceable for use in cases of adult erysipelas of the scalp, where it could be readily run in among the hair roots, as well as in cases of adult erysipelas of the trunk and extremities, where considerable areas were generally involved,



FIG. 1.—Crystallization of the tincture of chinosol containing sodium chloride. (Saturated type tincture). The crystallization is quite different when the sodium chloride is not combined with the chinosol.

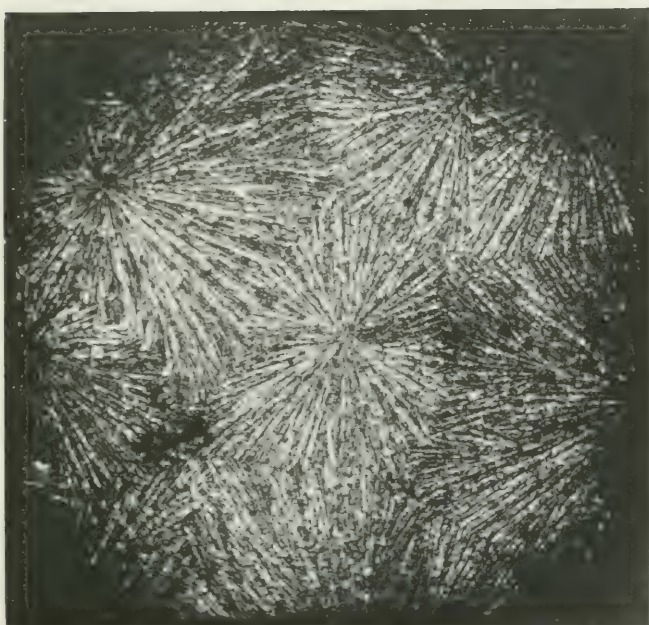


FIG. 2.—The tincture of chinosol. Interlocking systems of radiating rods (usual).



FIG. 3.—The texture of clinosol. Rods, diverging fan-shaped in usual type but an unusual pattern.



FIG. 4.—The texture of clinosol. Diverging rods, splintering apart to form a lacework (usual).



FIG. 5.—The texture of clinopyroxene. Curvilinear branching yellow scales with masses of irregularly disposed yellow crystals among the branches of this type of crystallization is often found in small quantity. This pattern is thus far unique. Projecting needle crystals at upper margin.

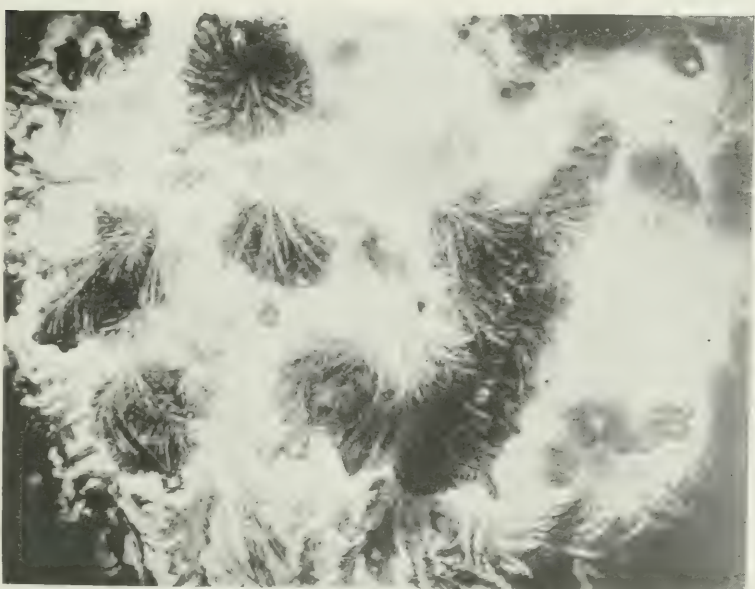


FIG. 6.—The texture of clinopyroxene. The usual appearance (fracture) of the type of crystallization shown in Fig. 5.



FIG. 7.—The fracture of chinosol. Irregular elongated yellow islands with pinkish translucent straight lines in their long axes from which arms project laterally which are parallel to each other, two lines often intersecting to form the figure of a cross (unusual crystallization).

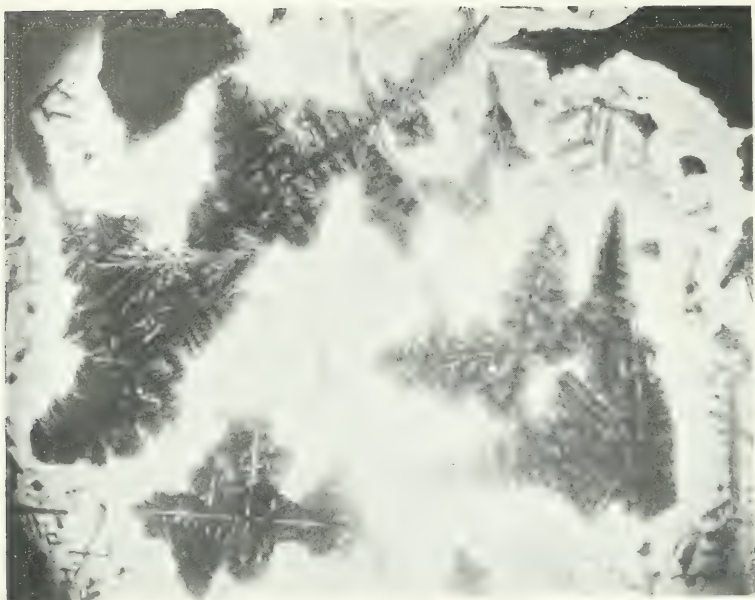


FIG. 8. — Similar to Fig. 7.

TREATMENT OF ERYSIPELAS WITH CHINOSOL

whose painting with the tincture with a camel's-hair brush could be more readily accomplished than could the application of the ointment.

The formula for making the tincture of chinisol is as follows:

R	
Aquæ dest. (10 parts)	℥i ss m xlviii
Boil and make cold in ice-box	
Then add and dissolve	
Chinosol powder (2½ per cent.)	grs. cxcii
Then add	
95 per cent. alcohol (70 parts)	℥xi ℥i m xxxvi
Shake and add	
Acetone (20 parts)	℥iii ℥i m xxxvi
Shake and add without delay, because otherwise a precipitate of chinisol will soon begin to form	
Sodium chloride (reagent)	grs. xcvi
Shake vigorously five to ten minutes	
A flocculent precipitate will now form which soon redissolves	
The insoluble residue is sodium chloride	
Let stand over night and then strain through sterile cotton.	
Sig.—Tincture chinisol with acetone and sodium chloride.	

NOTE.—This tincture of chinisol has also been useful, by painting it on a skin surface, to reduce inflammatory swelling extending to a distance from a focus of infection; painted on freely once in four hours, it has seemed of avail in two or three cases of phlebitis; it has allayed eczema in a few cases, relieving the itching, and has relieved itching in a case of shumack poisoning. Painted on a granulating ulcer and the adjoining skin, and the ulcer then strapped with ZnO adhesive plaster, once in two days, it stimulates epithelial growth. Painted on the skin around a discharging boil, it prevents further hair-follicle infection. Also painted on the skin once in four hours, it has checked lymphangitis.

In making up the tincture of chinisol, the glass receptacles and utensils used, should be scoured with neutral sodium oleate and should then be boiled in plain water. An alkali will precipitate oxyquinolin from the chinisol (oxyquinolin sulphate), so that soda should not be put into the water used for boiling. Nor should the glass be treated with hydrochloric acid. A glass vessel is preferable to an enameled one as a container, since spots of bare iron, usually present in the latter receptacle, will discolor the chinisol. For the same reason any tin in the make-up of a camel's-hair brush should be cut away and the hair of the brush simply bound with a thread to a stick for a handle.

The acetone, in the proportion here used, is capable of dissolving but a very small amount of grease, but it probably facilitates penetration into the hair follicles, and, under ordinary conditions of weather, it hastens materially the time of evaporation of the tincture. In very humid weather a specimen of this tincture poured on a glass slide will not completely evaporate, the liquid which remains evidently being the water content of the tincture, the evaporation of which is apparently prevented under these circumstances by the presence of the sodium chloride. Yet in humid weather the tincture will be taken up by the skin nevertheless.

The addition of the sodium chloride as a component in the tincture of chinisol causes a considerable flocculent whitish precipitate to be thrown out, which on microscopic examination is seen to consist of fine needle-like crystals, which soon go into solution, leaving no undissolved chinisol, but there remains a large residue of sodium chloride. Since without the addition of the sodium chloride a considerable amount of the yellow chinisol powder would speedily precipitate out of the alcoholic solution, it can be seen that the addition of the sodium chloride produces some change in the chinisol which renders it more soluble. If before the addition of the sodium chloride, yellow chinisol has already precipitated out, with the addition of the sodium chloride and shaking of the mixture, the yellow chinisol will redissolve. As, in the aqueous solutions of chinisol, the addition of sodium chloride alters the crystallization, so, in the tincture the sodium chloride transforms the picture of crystallization usually into one of many interlocking systems of rods radiating from centres, which produce the effect of many sunbursts (Figs. 1 and 2). If the later stages of crystallization of the tincture be observed under the microscope, these rods can be seen to be laid down by actual growth from the centres of the systems, they elongating very rapidly in this quickly evaporating fluid, until those of adjoining systems come clashing together and interlock. The picture may, as well, be one of rods diverging fan-shaped (Fig. 3), often splitting apart to form a lacework (Fig. 4). Another variety of crystallization often found in small quantity in this tincture is one which, when the deposit is thin, can be seen to consist of narrow, coarsely granular translucent yellow, branching stalks, the latter curvilinear in outline, the branches generally arching laterally from the stalks and supporting thick masses of irregularly arranged elongated, yellow crystals, which project in jagged formation at the margins (Fig. 5). Where the deposit is thick, translucent yellow stalks stand out more or less prominently in the midst of darkened areas interspersed among them (Fig. 6). Occasionally the evaporated specimen of the tincture presents irregularly elongated yellow crystalline islands, in the long axis of each of which a clear translucent straight line, usually pinkish in color, runs, from either side of which arms may project nearly perpendicularly, which are parallel to each other, two lines often intersecting to form the figure of a cross (Figs. 7 and 8). Thus an examination of the crystals can readily determine whether or not this tincture contains the correct product, and should be made use of to guard against error.

Crystallized chinisol, untransformed by sodium chloride, may present little greenish-yellow islands, finely granular, bordered with a network of ropes or flagellæ, or else stretches of the same greenish-yellow formation interspersed with open spaces into which bordering flagellæ project; or there may be a finely granular brownish deposit; or, sometimes the chinisol is deposited, apparently most often out of alcoholic solution, in patterns of clear translucent yellow and dark brown, the latter areas changing on deeper focussing to translucent pink.

It was of interest that, while sodium chloride is but little soluble in alcoholic solution, nevertheless, in order to get mostly all crystals of the sunburst or the diverging rod patterns, which apparently represent the highest degree of transformation of the chinisol, it was necessary to add as much as grs. vi of sodium chloride to the ounce of the tincture, which amount is in large excess of that which is readily soluble in this tincture. In the crystallized specimen of this tincture a rather limited number of salt cubes are seen. With the use of a greater amount of sodium chloride (grs. x- $\bar{5}$ i) a greater number of salt cubes were found in the crystallized specimens, which increased quantity was thought to be an element possibly unfavorable for the absorption of the chinisol through the skin. In the making up of the tincture here described, the sodium chloride (grs. vi- $\bar{5}$ i) should be added last of all, with which technic, the resulting flocculent precipitate goes most rapidly back into solution, also the transformation in the crystallization of the chinisol is then more completely into the sunburst and diverging rod types (*i.e.*, with little or no substratum layer), which crystals are regarded to indicate the highest degree of transformation, and the number of sodium chloride cubes found in the crystallized specimen has seemed to be very few in number. When the sodium chloride was added to the aqueous solution of the chinisol preceding the alcohol and acetone, the precipitate which formed on adding the alcohol did not dissolve for a number of days, and a much greater quantity of sodium chloride cubes was found in the crystallized specimen.

This tincture, as well as others, in which the chinisol was always in the same proportion ($2\frac{1}{2}$ per cent.), but the proportions of alcohol, acetone and sodium chloride varied a little, applied freely to the skin three times a day and twice at night, has never been observed to cause any skin irritation, either when used alone or when preceded with an ether wash. At one time when the tincture of chinisol was being generally used on all the erysipelas cases, nurses who were applying this lotion on cotton with their bare hands, going from case to case three times a day, sustained no ill effect whatever. Nor was any evidence of skin irritation observed in a few young children and infants on whom it was used five times in the twenty-four hours, though the babies always cried when it was being painted on them, and so the ointment was substituted for general use in children. Only once has this tincture been known to irritate a skin surface, and that was when it was applied to the latter on gauze which was covered with rubber tissue. On the other hand, a tincture of about 2 per cent. chinisol with acetone having no sodium chloride constituent, when applied to the skin following an ether wash, caused much smarting, and after a very few applications excoriation of the cuticle ensued. Without the preliminary ether wash, the latter tincture could however be applied to the adult skin freely twice a day for some time without causing irritation. Thus it can be said that the sodium chloride in the tincture of chinisol here described, acts in some way upon the chinisol, in addition to increasing its solubility, to render it practically non-irritating, the accompanying change in the crystallization probably being of associated significance.

The Treatment.—The work was done in the erysipelas ward of Bellevue Hospital, in the rush of a large and exacting service. The cases here enumerated were admitted in the period from February 10, to March 25, 1921.

The routine treatment consisted in the use of the chinisol ointment for all adult cases of facial erysipelas and for erysipelas affecting any part of the body in children, and the use of the tincture of chinisol, preceded (after March 9th) by a wash of the skin surface with ether, for all adult cases of erysipelas of the scalp, trunk and extremities. Treatments were administered three times during the day, at four-hour intervals, and twice at night. In cases of facial erysipelas, eyelids which had not swelled were always anointed from the start, just the same as the swollen lids, with the intent to forestall swelling. Owing to the fact that bacteria had been found by the writer in considerable abundance in the subcutaneous fat beneath the normal-appearing skin one inch in advance of the line of demarcation of the erythema, the area treated included a belt of the normal-appearing skin, three or four inches in width, adjoining the line of demarcation.

The technic of applying the ointment was by gently smearing it over the skin surface, its disinfectant action on the tissues probably being more effectual when spread somewhat thickly rather than thinly. The eyelids, however, should, with intention, be but sparsely covered with the ointment, with a view of preventing the latter from getting into the eyes, which occurrence is more likely to happen in warm weather, when the consistency of the grease is lessened. An excessive amount of ointment on the eyelids should be wiped off with cotton. The best applicator for spreading the ointment over the irregularities of the face was a wooden tongue-depressor, which was serviceable as well for applying the ointment to other parts of the body. For rapidity of action the ointment was at times swabbed over the skin surface with a piece of gauze, with which procedure, however, care should be taken not to use too much force.

The Technic of Use of the Tincture.—It seemed that, in the treatment of erysipelas of the scalp and back with the tincture of chinisol, it was of considerable importance, in the attempt to effect control of the disease, to precede the application of the tincture with an ether wash, so that after March 9th this technic was put into general practice for the treatment for all skin areas affected with erysipelas. The ether should be applied with cotton, which it should fully saturate, the skin being gently washed with the same, after which the tincture should be painted on freely, most readily done with a large camel's-hair brush, in several successive layers as drying of each occurs, which takes place rapidly. In applying this technic to a hairy scalp, cotton was the best medium for bringing the ether, which should saturate it, against the skin of the scalp, which is done by sopping the ether out of the cotton into the hair and working the ether-soaked cotton gently around over the hair against the scalp, with the fingers, which comes as near as it is possible to wiping the surface of the scalp. The tincture of chinisol should then follow, either by pouring it into the hair, or else sopping it on

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bountifully with the large camel's-hair brush, and then perhaps working it very gently around the hair roots with the tips of the fingers. Both the ether and the tincture should be used liberally. In making these applications to the scalp, the eyes should be protected with gauze. The cheaper sulphuric ether for skin cleansing serves every purpose.

The best results with this technic seemed to be obtained when time could be taken to allow a number of superimposed layers of the tincture of chinisol to evaporate one after the other on the skin surface, which, besides causing a larger deposit of chinisol, probably ensures as well a deeper penetration of the same into the hair-follicles. The presence of the acetone makes the taking up of this tincture by the skin very rapid. In the treatment of erysipelas spreading from a wound which had to be covered with a dressing, as in the case of operative wounds of the mastoid, the tincture was readily applied to the affected skin beneath the dressings by sopping it into the dressings at the appointed times, no irritation having resulted from this technic. It was also found that ichthyol and collodian, tightly adherent to tender areas of skin affected with erysipelas, could be readily removed by washing the areas with this tincture of chinisol.

When erysipelas of the face, treated with the chinisol ointment, involves the forehead or the ears, the adjoining normal-appearing scalp should, without any delay, be treated with ether and the tincture of chinisol, in order to try and destroy the bacteria lying in the tissues around the hair line in advance of the inflammatory zone, just the same as the skin area beyond the erythema is treated in other parts of the body.

The Results.—The test of the efficiency of the treatment was sought in the control of the spread of the erysipelas and not in the control of the temperature, which latter would frequently rise to a high point and fall, without any apparent extension of the disease, particularly in cases with much swelling. In cases with much swelling, with no spread of the erysipelas, it has seemed a foregone conclusion that the temperature was going to have a daily rise nevertheless, until the swelling had reduced.

The cases comprise:

I. Adult erysipelas of face and scalp treated with the chinisol ointment and the tincture of chinisol, respectively.

	Per cent.
(a) Cases without spread after admission	24 (33.8)
(b) Cases without recorded observation on second day, which afterward had no spread	3 (4.2)
(c) Cases which showed spread only on second day	7 (9.9)
(d) Other cases which had but one day of spreading	4 (5.6)
(e) Cases without recorded observation on second day, which afterward had but one day of spreading	3 (4.2)
(f) Cases having two days of spreading	6 (8.4)
(g) Cases having three days of spreading	9 (12.7)
(h) Cases having more than three days of spreading	7 (9.9)
(i) Cases having recurrence during treatment	4 (5.6 per cent.)
Less cases included in Class (h)	2

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(k) Cases of recurrence following primary subsidence	2 (2.8)	
Less cases included in class (h)	I	
	—	I
(l) Miscellaneous	2 (2.8)	
(m) Died	3 (4.2)	
	—	
Total		71
II. Adult erysipelas of extremities treated with the tincture of chinisol.		
(a) Cases without spread after admission	4 (50)	
(b) Cases having one day of spreading	3 (37.5)	
(c) Case having three or four days of spreading	1 (12.5)	
	—	
Total		8
III. Children's erysipelas of face treated with the chinisol ointment.		
(a) Cases without spread after admission	6 (75)	
(b) Cases having three days of spreading	2 (25)	
	—	
Total		8
IV. Children's erysipelas of trunk and extremities treated generally with the chinisol ointment.		
(a) Case without spread after admission	1 (12.5)	
(b) Case having one day of spreading	1 (12.5)	
(c) Case of early recovery	1 (12.5)	
(d) Case having two days of spreading	1 (12.5)	
(e) Case with twelve days of spreading	1 (12.5)	
(f) Died (one recurrence)	3 (37.5)	
	—	
Total		8
		—
Grand total		95

The important facts regarding each of these cases are given in the accompanying tables.

Three cases of pneumonia with facial erysipelas, two of them infants, who died on the second or third days after admission, were omitted from this series, since they were essentially cases of pneumonia, as well as several cases of recurrent erysipelas whose primary attacks had not been treated by the technic herein outlined.

Two of the deaths in Group I (adult erysipelas of face and scalp) resulted from pneumonia, and one from cedema of the glottis.

Two of the cases in Group IV (children's erysipelas of trunk and extremities), who died, were infants who suffered from malnutrition, and the third case who died, aged fifteen months whose erysipelas ran its course for three weeks, suffered from anæmia and cervical adenitis.

Record was made each morning at rounds on a general chart containing the names of all the cases, as to whether or not spread had taken place since the preceding morning. It was not always possible to determine on the morning of the second day whether or not spread had taken place since admission of the patient to the hospital, nor was it considered very disparaging to the method of treatment where a single spread of the erysipelas took place between the time of admission and the morning of the second day, since the

remedies would then have had only a short space of time in which to have gotten in their effect. Thus the cases of classes *b* and *c* of Group I, which had a possible or actual spread of the erysipelas on the second day only, might be added to those of class *a* in the same group, to support the argument in favor of the serviceability of this remedy to control erysipelas in a considerable proportion of the cases.

In an acute case of erysipelas with much swelling and tension, treated as herein described, the original swelling would very soon begin to reduce and if no extension took place, the patient would thereupon be made more comfortable. If spread occurred, however, then pain would affect the newly invaded area.

In an extensively spreading case, with this treatment, the areas primarily affected become healed and normal in appearance as the advance takes place. Thus erysipelas of the face and scalp has been seen to become healed as the disease has spread down the back, while the erysipelas of the trunk will in turn heal as spread therefrom takes place down the extremities, sometimes in the latter situations the erythema forming simply a narrow strip, or a cuff from one or two to a dozen inches in length, from the lower margin of which, the advance proceeds.

With the use of the chinisol ointment for the treatment of facial erysipelas, the early reduction of the swelling of already swollen eyelids, and the occurrence of but a comparatively small amount of swelling in eyelids which became swollen after admission, were noticeable features, there having been but little tendency for the eyelids to suppurate (but one eyelid—Case No. 29—in seventy-one cases of adult facial and scalp erysipelas).

Since chinisol *in vitro*, while a powerful antiseptic, is but little germicidal, it would seem not at all improbable that its ability to disinfect vitalized tissue, the truth of which has been demonstrated by the writer,* was due to a power to stimulate phagocytosis. If this supposition be true, then, other things being equal, the variation in response of some of the cases of erysipelas to the method of treatment here described, would seem explicable on the ground of varying degrees of resistance among the cases, with corresponding variation in response of their tissues to the supposed phagocytic stimulus.

A cure of the erysipelas was regarded to have taken place on the subsidence of the inflammatory swelling and the fading of the distinctive erythema, accompanied, in cases having no other febrile condition, with a drop of the temperature to normal without subsequent rise. Some of the cured cases who were discharged on the second consecutive day of normal temperature were given a small box of the chinisol ointment to use at home. But two discharged cases (Nos. 65 and 66) in this series returned with recurrences, one of which was afebrile.

Four cases of facial erysipelas (Class *i*, Nos. 61 and 64) suffered *recur-*

* Lusk. "The Disinfection of Vitalized Tissues and the Healing of Wounds with Chinisol and Salt" (A Foreword). *ANNALS OF SURGERY*, 1919, pp. 493-497.

TABLE I
Adult Facial and Scalp Erysipelas Treated with Chinosol Ointment and the Tincture Respectively.

No.	Name	Age & Sex	Complications	Day of Disease	Location on admission	Special treat.	Days of Spread	Estimated Duration	Sequels	Result
<i>(a) Cases without spread after admission</i>										
1.	N.H.	47 m.	Post-op-mastoid right; alcoholism; D. T. S.	3	Facial with marked swelling		0	10th day. Temp. drop normal w/out subseq. rise		15th day Dis. C.
2.	D.M.	21 m.		2	Entire face. Eyes almost closed		0	3d day. Drop to normal & thereabouts (99.4)		9th day Dis. C.
3.	J.D.	37 m.		3	Entire left face involving scalp & crossing nose		0	5th day. Drop normal w/out rise		9th day Dis. C.
4.	A.H.	19 m.		3	Nose, eyelids, forehead. Eyes wide open		0	Highest temp. 99.8		3d day Dis. C.
5.	C.L.	24 m.		6	Chin		0	3d drop normal w/out rise		5th day Dis. C.
6.	C.O.	42 fem.		1	Face incl'g forehead		0	8th drop normal w/out rise		11th day Dis. C.
7.	J.K.	58 m.		3	Right cheek, ear & nose		0	3d day. Drop normal w/out rise		7th day Dis. C.
8.	H.R.	45 m.	Febrile condit. Cardiac. Nephrit.	1	Left cheek & nose		0	6th day. Erys. condit. clear		6th day Dis. Erys. C.

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9.	A.A.	45 m.	4	Both cheeks & nose		0	8th. Drop ar. normal w/out rise	11th day Dis. C.
10.	A.S.	28 fem.	5	Cheeks, ears forehead & scalp	Scalp ether & tinct. Face oint.	0	5th day. Drop normal w/out rise	8th day Dis. C.
11.	W.H.R.	68 m.	4	Entire face. Eyes partially closed		0	6th day. Drop normal w/out rise	9th day Dis. C.
12.	P.F.	50 m.	2	Scalp and neck	Tincture	0	3d day. Drop normal w/out rise	4th day Dis. Erys. C.
13.	D.B.	50 m.	2	Lt. cheek & eyelids. Lt. eye closed		0	4th day. Drop normal w/out rise	6th day Dis. C.
14.	C.M.	57 m.	2	Forehead & skin abt. orbits. Left eye closed		0	3d. Drop normal with rise to 99.2	6th day Dis. C.
15.	M.S.	40 fem.	8	Entire face, ears & part of scalp. Eyes partially closed.	Ointment	0	3d. Drop normal w/out rise	6th day Dis. C.
16.	J.F.	37 m.	8	Rt. side face & neck. Eye partially open		0	2d. Drop normal w/out rise	6th day Dis. C.

TABLE I— (Continued)
Adult Facial and Scalp Erysipelas Treated with Chinosol Ointment and the Tincture Respectively.

No.	Name	Age & Sex	Complications	Day of Disease	Location on admission	Special treat.	Days of Spread	Estimated Duration	Sequels	Result
(a) <i>Cases without spread after admission</i> (Continued)										
17.	S.L.	49 m.	Heavy drinker. Corpulency	6	Face incl'g. forehead		0	6th. Drop normal w/out rise		7th day Dis. C.
18.	T. McG.	54 m.		5	Nose, forehead & molar regions Eyes open		0	5th. P.M. drop normal w/out rise		6th day Dis. C.
19.	H.L.	46 m.	Cellulitis behind right elbow	7	Face		0	3d. P.M. drop normal with slight rise (99.6)		8th day Dis. Erys. C.
20.	J.R.	22 m.		3	Nose, eyes, cheeks & forehead. Eyes not closed		0	5th. Drop normal w/out rise		6th day Dis. C.
21.	J.M.	18 m.		4	Left face (vesicated)		0	4th. Drop normal w/out rise		5th day. Dis. C.
22.	C.H.	45 fem.		4	Nose & adjoining cheeks		0	2d P.M. drop to ar. 99° (lasting) 5th 100.4°		6th day. Dis. C.
23.	K.F.	36 m.		4	Face markedly swollen. Eyes closed		0	4th. Drop normal w/out rise		5th Trsf'd. Erys. Continued 9th day Dis. C.

TREATMENT OF ERYSIPELAS WITH CHINOSOL

24.	G.B.	47 m.	3	Left ear & side of neck	0	3d day. Drop normal without rise	4th day. Dis. C.
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(b) Cases without recorded observation on 2d day which afterward had no spread

25.	A.K.	63 m.	6	Face, incl'g ears. Eyes nearly closed	2d. No observation otherwise 0	Temp. low 3d. Drop normal essentially w'out rise 5th 99.6	6th day. Dis. C.
26.	M. McN.	67 fem.	5	Entire left cheek & eye-lids. Eyes partly closed	2d. No record. Otherwise 0	2d. drop normal w'out rise	8th day. Dis. C.
27.	D.J.	28	?	Left face. Eye not closed	2d. No record & no oint. Oth wise 0	4th. Drop normal w'out rise	8th day. Dis. C.

(c) Cases which spread after admission, only on 2d day

28.	M.G.	52 m.	1	Face, left side	2d day—fore-head	3d. Drop normal w'out rise	5th day. Dis. C.
29.	H.C.	51 m.	4	Face, incl'g. lids of both eyes & forehead	11 to 13 days (inclusive) treat. interrupted following a 2 day drop temp. to normal	16th. Drop normal w'out rise	18th day. Dis. Erys. C.

TABLE I (Continued)
Adult Facial and Scalp Erysipelas Treated with Chinosol Ointment and the Tincture Respectively.

No.	Name	Age & Sex	Complications	Day of Disease	Location on admission	Special treat.	Days of Spread	Estimated Duration	Sequels	Result
30.	T.B.	40 m.		3	Face, incl'g. forehead. Eyes nearly closed. Vesicles	Face & scalp (bald) treat. up to 10th day with oint.	2d day to scalp	5th. Drop normal w/out rise		11th day. Dis. C.
31.	S.B.	53 fem.	Corpulency	3	Entire face incl'g. forehead		2d day	3d. Drop normal w/out rise		5th day. Dis. C.
32.	P.T.	31 m.		4	Left eyelids, forehead, scalp & neck	Face, oint. Scalp, ether & tinct.	2d day	5th. Drop normal w/out rise		9th day. Dis. C.
33.	W.M.	37 m.		4	Rt. face & scalp excepting eyelids	Scalp, ether & tinct. Face, oint.	2d day	7th. Drop normal w/out rise		12th day. Dis. C.
34.	M.C.	40 fem.	Rt. eye irritated 4th day	3	Lt. face, ear & scalp. Eye closed	Ointment	2d to rt. side face	5th. Drop normal w/out rise		10th day. Dis. C.
(d) Other cases which had but one day of spreading after admission										
35.	M.R.	48 fem.		2	Left face incl'g. forehead		4th day scalp	7th. Drop normal w/out rise		11th day. Dis. C.
36.	T. McC.	60 fem.	Senility	2	Nose & adjoining face (butterfly)		4th ear (w/out elev. temp.)	2d. Drop normal w/out rise		11th day. Dis. C.

37.	O.N.	65 m.	5	Rt. face incl'g. forehead, extending to left	4th scalp	8th. Drop normal until 14th, 99.4	16th day abscess cheek Temp. 99.4	20th day Dis. Erys. C.
38.	I.C.	53 fem.	2	Left cheek	3d day	Temp. but little above normal		5th day. Dis. C.

(e) Cases without recorded observation on 2d day which afterward had but one day of spreading

39.	M.H.	48 fem.	4	Rt. face & neck incl'g forehead	2d. no record 3d. Left face & ear	9th. P.M. normal (subsequent rise)		10th. Trsid Erys. cont'd. 17th dis. w'out recur.
40.	C.C.	57 fem.	2	Face markedly swollen, incl'g forehead. Eyes partially closed	2d. No obsvn. 3d ?	9th. Drop normal w'out rise		11th day. Dis. C.
41.	L.F.	42 fem.	?	Face markedly swollen. Eyes closed	Face covd. w. ichthyol & colloid. 2d. No record 3d ?	Temp. not reduced to normal (arthritis) but erys. well on 11th day		14th day. Dis. Erys. C.

(f) Cases having 2 days of spreading after admission

42.	J.A.	20 m.	7	Rt. face, neck & ear	2d & 3d	7th. Drop normal w'out rise		11th day. Dis. C.
43.	A.S.	39 fem.	4	Rt. face, cheek, both ears. Rt. eye closed	Oint. face. Tinc. scalp 3d forehead, 6th scalp	9th. Drop normal w'out rise		11th day. Dis. C.

TABLE I—(Continued)
Adult Facial and Scalp Erysipelas Treated with Chinosol Ointment and the Tincture Respectively.

No.	Name	Age & Sex	Complications	Day of Disease	Location on admission	Special treat.	Days of Spread	Estimated Duration	Sequels	Result
44.	S.F.	44 m.		3	Face	Ether & tinct. to scalp, oint. face	6th scalp 8th	11th. Drop normal w/out rise		13th day. Dis. C.
45.	F.W.	62 m.	Convalescent grippe	4	Rt. eye closed. Face, incl'g forehead	Face, oint. scalp tinct. preceeded w. ether	2d 3d evidently to scalp	7th. Drop ar. normal w/out rise		11th day. Dis. C.
46.	F.O.	71 m.		3	Lt. face incl'g ear, eyelids		3d 4th	6th. Drop normal w/out rise		7th day. Dis. C.
47.	G.D.	26 fem.	Alveolar abscess	3	Lt. face & ear. Much swelling. Eye closed		2d 3d	5th. Drop normal w/out rise		7th day. Dis. C.
(g) ² / ₃ Cases having 3 days of spreading after admission										
48.	J.K.	38 fem.		?	Rt. face. Eye closed	4th back Oint. q. 2 hrs. day q. 4 hrs. nt. 5th back blotchy (above middle) Then controlled	3d back, 4th back, 5th back (blotchy)	5th. Drop normal w/out rise		12th day. Dis. C.

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49.	L.F.	37 m.	Post-op. mastoid	3	Neck & nearly entire face	4th upper back, ether & tinc. 6th back arrested & fading	2d 4th 5th } back	7th. Drop normal w/out rise	8th day. Dis. C.
50.	L.K.	27 m.		3	Nose, cheeks, lower lids, forehead		3d 5th 6th } to ear & scalp	7th. Drop normal w/out rise	11th day Dis. C.
51.	E.D.	20 fem.		5	Left face. Eye closed		3d 4th 9th slight	9th. Drop normal w/out rise	15th day. Dis. C.
52.	M.D.	37 fem.	Large fleshy	2	Cheeks, eyelids, forehead. Eyes partly closed		2d 3d 4th (no ointment)	6th. Drop normal w/out rise	7th day. Dis. C.
53	N.S.	40 m.		7	Left face eye almost closed Forehead & Rt. eyelids		2d (no oint) 3d 4th (scalp)	5th. Drop normal w/out rise	7th day. Dis. C.
54.	T.B.	45 m.	Eye chin. irritat. 4th & 8th 10th pol-yarthrits	5	Rt. side head incl'g scalp, forehead, ear & face. Eye partially closed		2d (no oint.) 3d 4th	10th. Drop normal, 11th rise	11th day. transferred Med. Wd. Erys. C.
55.	Z.L.	54 m.	Post-op. mastoid Left	2	Left ear, neck, cheek & forehead	Scalp not treated in advance of spread	2d 4th scalp 5th	8th. Drop normal w/out rise	10th day. Dis. C.
56.	H.F.	52 m.		5	Entire face & Scalp tender	Scalp not treated until 4th day (Eth. & Tinc.)	3d scalp 4th scalp 5th scalp	6th. Drop normal w/out rise	7th day. Dis. C.

TABLE I—(Continued)
Adult Facial and Scalp Erysipelas Treated with Chinolol Ointment and the Tincture Respectively.

No.	Name	Age & Sex	Complications	Day of Disease	Location on admission	Special treat.	Days of spread	Estimated Duration	Sequels	Result
<i>(h) Cases having more than 3 days of spreading after admission</i>										
57.	C.W.	69 fem.		3	Almost entire face incl'g forehead, extending to neck. Eyes almost closed		2d ? 3d scalp 4th neck 5th neck 7th 8th	9th. Drop normal w/out rise		13th day. Dis. C.
58.	P.S.	33 m.	Drug habitué	5	Rt. face & neck, incl'g ear	9th ether preced'g tinc. to back begun, 11th erysip. back arrested (blotchy)	2d 3d 5th left face 6th back of neck 8th 9th } back 10th }	11th. Drop normal w/out rise	Abscess of neck	13th day. Dis. Erys. C.
59.	P.B.	57 fem.		?	Face incl'g forehead	7th back (Ether & Tinc.) 9th back(upper $\frac{1}{2}$) 10th back arrested & fading	2d 7th back 9th back 13th sl.S. arm	10th. Drop normal highest subseq. rise 99.4 12th day		18th day. Dis. C.
60.	J.M.	42 m.		4	Entire face markedly red swollen & tender	Spread scalp accomp'd treat. by unskilled hands. 7th Ether & T. abundantly to scalp, foll'd by arrest	3d } 4th } scalp 5th } 6th } 7th }	8th. Drop normal & thereabouts (99.8) w/out rise		10th day. Dis. C.

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See also
Cases
Nos.
62, 64,
66

(i) Cases having recurrence during treatment

61.	A.S.	52 m.						9th recur- rence dur- ing reg. treat. with oint. foll'g cold draft on face	2d no record 9th Recurrence left face Temp. 100°	10th drop to nor- mal w/out rise		13th day. Dis. C.
62.	G.H.	52 m.	Steady drinker	4	Face & ears	Rt. side of face Rt. eye closed	Scalp, tinct. Face, oint.	2d no record 4th to forch'd 5th to scalp 8th re- cur rt. face. 9th recurrence	11th drop to nor- mal w/out rise			17th day. Dis. C.
63.	M.J.	35 fem.		5	Face & scalp marked swelling Eyes almost closed	First 4 days ointment to scalp, then tinct.	Face, oint. Scalp, ether & tinct, 13th day	2d no record 6th recurrence both cheek & nose (had rubbed face)	7th. Drop to nor- mal w/out rise			8th day. Dis. C.
64.	J.F.	36 m.		6	Rt. face & ear. Eye almost closed	Face, oint. Scalp, ether & tinct, 13th day	5th 6th 12th recurr. lower lids & adjoining cheeks (99.6°) (Had not rub- bed face.) 13th 14th	10th temp. drop to normal for 3 days. Then rose again (102°), 15th temp. 100.8°				16th day. Dis. C.

TABLE I—(Continued)
Adult Facial and Scalp Erysipelas Treated with Chinolol Ointment and the Tincture Respectively.

No.	Name	Age & Sex	Complications	Day of Disease	Location on admission	Special treat.	Days of spread	Estimated Duration	Sequels	Result
65.	R.O.	39 m.	Cardiac valvular dis. Pulsating liver	5	Nose & cheeks (butterfly)		0	4th. Drop normal w/out rise		5th day. Transferred Med. W.d.
65.	Recur		8th rt. conjunctiva ac. swollen	2	After 10 days Recur. chiefly left face	Boric acid reduced conjunctival swelling before death	2d no record 3d scalp 8th rt. upper lid (temp. normal)	5th. Drop normal w/out rise		9th day. Died
66.	V.S.	25 fem.	Marked kyphosis Post-op. mastoid	1	Around rt. eye which was closed	Spread to ear scalp & 1/2 way down back where controlled with ether & tinct.	2d 5th 8th back 9th 11th back of head 14th 16th eyelid	15th. Drop normal without rise		18th day. Dis. C.
66.	Recur.				Swelling rt. eyelids 5 days after discharge			No elev. temp.		Rapid subsidence
(l) Miscellaneous										
67.	P.H.	39 m.		3	Face, both sides	Face oint. Scalp, ether & tinct.	2d) no record 3d) Evident spread scalp Otherwise 0	6th. Drop normal w/out rise		8th day. Dis. C.

68.	L.L.	32 m.		3	Face, ears & scalp markedly swollen. Eyes almost closed	Face, oint. Scalp, ether & tinct.	2d } no record 3d } Otherwise o	6th. Drop nor- mal w out rise	8th day. Dis. C.
<i>(m) Cases who died</i>									
69.	S.M.	38 fem.	Synovitis rt. knee. Pneumo- nia	6	Both cheeks & forehead		2d no record Otherwise o		5th day. Died
70.	J.G.	61 m.	Pneumo- nia	3	Eyelids, cheeks, forehead		o		5th day. Died
71.	A.P.	40 fem.	Oedema glottidis	Ab. 8	Face, scalp, upper neck. Eyes closed. Mar- ked swelling				2d day. Died

TABLE II
Adult Erysipelas of Extremities treated with the Tincture of Chinosol.

No.	Name	Age & Sex	Complications	Day of Disease	Location on admission	Special treat.	Days of Spread	Estimated duration	Sequels	Result
1.	M.G.	50 fem.	Small ulcer rt. leg	7	Lower $\frac{1}{4}$ rt. leg. Entire leg swollen Lymphangitis. Ing. glands tender	Tincture	0	4th. Temp. drop normal w'out subseq. rise		8th day. Transferred Erys. C.
2.	S.Z.	55 fem.		5	Rt. leg (to below knee) & foot. Ing. glands tender	Tincture	0	7th. Drop normal w'out rise		11th day. Dis. C.
3.	E.F.	35 fem.		5	Entire rt. leg	Ether & tinct. Oint. added at beginning	0	9th. Drop normal w'out rise		14th day. Dis. C.
4.	A.R.	58 fem.	Varicose ulcer rt. leg	4	Entire lower part of right leg	Tincture	0	3d. Drop normal w'out rise		9th day. Dis. Erys. C.
5.	J.C.	45 m.	History of tuberculosis. Ulcer rt. leg	4	Rt. lower extremity, diffuse areas. Ing. glands tender	Ether & tinct.	2d Soreness continued until near end of stay	After 4th day temp. gen'ly not over 100°		14th day. Dis. C.
6.	C.C.	63 m.	Suppurating wound axilla. left	2	Left side chest & arm	3d, back, arrested. Tinct. chin. gen'ly preceded. w. ether. At night sts. oint.	2d to back (blotchy). No further spread	Had but little rise of temp.	Increasing oedema incl'g hand, no pus, prob. thrombosis	11th day. Home

TREATMENT OF ERYSIPELAS WITH CHINOSOL

7.	M.M.	35 fem.	I	Left leg (to be- low knee) Mar- ked swelling	Tincture chin. But little ether recorded used	6th	7th. Drop nor- mal with rise to 99.2°. 10th treat- ment stopped	8th blister heel	14th day Dis- Erys. C.
8.	W.R.	44 m.	4	Left leg	Ether & tinct. 3d, foll'g. gfr. abundance of ether & tinct. swell- ing reduced 6th, few blisters oint. used applied by nurse	2d } little 3rd } spreadings 4th } localized 8th } extension of swelling. No further spread	6th. Drop with daily rise to around 100°.	12th } 16th } Small ab- scusses	

TABLE III
Facial Erysipelas in Children Treated with Chinosol Ointment.

No.	Name	Age and Sex.	Day of Dis.	Location on Admission	Days of Spread	Estimated Duration	Result
1.	E. McG.	6 yrs. m.	3	Cheeks & chin	0	Temp. but little above normal	6th day. Dis. C.
2.	A. L'A.	10 yrs. m.	3	Rt. face, ear, forehead & scalp	0	But little elev. of temp.	6th day. Dis. C.
3.	F. Z.	1½ mos. m.	4	Rt. face	0	4th day temp. normal all day 5th day 100.4	6th day. Dis. C.
4.	E. F.	10 yrs. m.	3	Left face, incl'g. ear & foreh'd	0	7th day temp. normal all day	8th day. Dis. C.
5.	C. S.	15 yrs. fem.	3	Nose, cheeks, eyelids, forehead	0	6th A.M. drop normal without rise	7th day. Dis. C.
6.	J. C.	5 yrs. m.	3	Forehead	0	3d day drop normal without rise	4th day. Dis. C.
7.	T. K.	15 mos. m.	1	Face & neck spreading fr. submental wd.	2d } 3d } no observation 4th spread. Otherwise no spread	6th day drop normal practically without rise	8th day. Dis. C.
8.	J. S.	3 yrs. m.	2	Rt. face, ear and neck	3d to back 4th back 5th arms	7th day redness decreasing	10th day Dis. C.

TABLE IV
Children Erysipelas of Trunk and Extremities Treated with the Chinosol Ointment.

No.	Name	Age and Sex	Complications	Day of Disease	Location on Admission	Special Treatment	Days of Spread	Estimated Duration	Result
1.	R. W.	4 fem.	Infected finger		Whole rt. upper extrem. & shoulder		0	7th. Drop normal w'out rise	9th day. Dis. Erys. C.
2.	R. V.	3 fem.		3	Lower leg, left		2d to knee Lymphangitis inner thigh	5th. Drop normal with rise to 100°	7th day. Dis. C.
3.	S. M.	18 mos. fem.		Re- cent	Left leg from knee to ankle		No early observations made, but	3d. Drop normal w'out rise	8th day. Dis. C.
4.	G. J.	3 mos. fem.		3	Back	Erysipelas back checked	4th to arms 5th slight spread	7th. Drop normal practically w'out rise (99.4) 8th erys. well	9th day. Dis. C.
5.	W. H.	2 m.	Double otitis media purulenta. Wound of neck. Anaemic	3	Left forearm, arm, shoulder	Pr. abt. 7th to 12th days, oint. q. 2 hrs. day & q. 4 hrs. nt., sts. preceded by the tinct. but ether wash given only once per day. Oint. prac. over entire trunk & extremities. Pr. 12th to 14th tinct. used exclusively q. 4 hrs. togeth. w. some ether ar. sites of advance. 14th oint. exclusively	Pr. 5th to 14th daily spread trunk & extremities 14th isolated patch face 15th isolated patch face	Temp. ar'd. 104° until 10th day, ° Then genly 102° to 103°. Pulse good. 16th drop normal w'out rise 17th erys. well	24th day. Dis. C.
6.	I. P.	15 mos. fem.	Abscess neck, Enlarged cerv. glands. Anæmia	1	Back	Oint. 13th. Began applications q. 2 hrs. day & q. 4 hrs. night	2d to 5th (incl.) 7th to 10th (incl.) 12th to 18th (incl.) 20th Recur. body 21st erys. faded	Temp. varied bet. 100° to 101° & 104° to 105° levels 20th 108.6°	22d day. Died
7.	A. S.	2 mos. m.	Malnutrition	7	Scalp, neck, face, chest, abdomen	Oint. q. 4 hrs.	Spreading unchecked	Temp. high	5th day. Died
8.	C. M.	5 wks. m.	Malnutrition	?	Diffuse about body				3d day. Died

rences following primary reduction of the inflammation, while still undergoing treatment in the ward. In Case 61 the lighting up of the subsiding inflammation was attributable to exposure to a cold draft, and in Case 63, to the trauma produced by the patient's having rubbed the ointment into her face, in both of which cases the temperature dropped to normal on the day following the appearance of the recurrence, without subsequent rise. In patients 62 and 64 there was no assignable reason for recurrence having occurred. Patient No. 64 had positively not rubbed his face. Case 6, Group IV, I. P., age fifteen months, spreading erysipelas of trunk and extremities complicated with cervical adenitis and anæmia, on the twentieth day of treatment, long after the erysipelas involving the trunk had cleared, though the extremities still harbored the disease, had a recurrence of the erysipelas to a considerable extent over the surface of the trunk somewhat irregularly. On the twenty-first day the erysipelas had everywhere faded and on the twenty-second day the patient died.

Of particular interest were the *cases of erysipelas which had more than three days of spreading*. (Group I, Class *h*, Cases 57 to 60 inclusive; Class *i*, Cases 62 and 64, and Class *k*, Case 66, and Group IV, Cases 5 and 6). In Case 58 it is noteworthy that the erysipelas of the back did not begin to control until ether was used on the skin surface preceding the application of the tincture of chinisol. In Case 60 erysipelas of the scalp, treated by unskilled hands, spread continuously for five days, but with the use of a correct technic, applying ether and the tincture of chinisol lavishly and extensively, it promptly became controlled. On the day following the institution of the proper technic in this case, all that remained of the soreness and swelling of the scalp, which had been extensive on the previous day, was limited to a small area over one ear.

In two children with erysipelas of the trunk and extremities (Group IV, Nos. 5 and 6), *the erysipelas spread for days unchecked by the treatment*, though the advance of the disease was slow. Case 5, W. H., a male child of two years of age, was complicated with anæmia and a double purulent otitis media with much discharge from the ears at the beginning of treatment. The ointment applied once in two hours in daytime and four hours at night was unavailing to stem the advance of the erysipelas. The use of the tincture of chinisol in conjunction with the ointment, without first washing off the grease from the skin with ether, as practiced on this patient, was not regarded to be a correct technic. Attending the exclusive use of ether and the tincture of chinisol once in four hours from the twelfth to the fourteenth days, the erysipelas of the trunk and extremities largely cleared and otherwise became checked, and then with the appearance of two isolated areas of erysipelas on the face, the disease, now treated with the chinisol ointment again, rapidly cleared entirely. The pulse continued good throughout.

Case 6, I. P., female, age fifteen months, thin, complicated with cervical adenitis and anæmia, was treated with the ointment exclusively, the same having been applied at first with routine frequency, but on and after the

thirteenth day once in two hours by day and four hours by night. On the twentieth day the temperature rose to 108.6° , on the twenty-first day the erysipelas had entirely faded, the breathing was tranquil, the pulse regular and not excessively rapid, and on the twenty-second day the patient died. A final examination of the lungs shortly before death, failed to detect any evidence of pneumonia. In this case the erysipelatous areas affecting the lower extremities were at one time each limited to a narrow red stripe encircling each leg, which were observed to have advanced in their entirety, leaving normal-appearing skin in the areas just traversed. The advance of the disease was slow. With rubbing the ointment into the skin at the stated intervals, during a period of forty-eight hours, the amount of spread of the erysipelas was greater than it had been when the ointment was applied by simply smearing it over the skin surface.

Another case of erysipelas which could not be checked by the treatment, not in the series of cases herewith reported, but introduced in order to add an adult case of this nature, was one beginning in the face of a woman K. M., age thirty-five, admitted to the service on March 30, 1921, in whom at first a chinisol ointment was used which differed from the one used on the series of reported cases, in that its content of sodium chloride was but grs. iiss to the ounce. The erysipelas spread unchecked through the scalp and down onto the body. On the sixth day, when the erysipelas had spread three-fifths the way down the back, one special careful treatment was administered, first washing the skin freely with ether and then painting on layer after layer of the tincture of chinisol until about $2\frac{1}{2}$ ounces of the latter had been taken up by the skin, but without avail. On the eighth day the same sort of ointment which had been used on the face was resorted to again for use on the body in place of the tincture. On the eleventh day the prior chinisol ointment, containing grs. iv of sodium chloride to the ounce, was substituted. After the twelfth day the ointment was applied to the skin surface of the entire body twice a day, while at the other three treatments it was applied only to the reddened areas and the skin in advance of the line of demarcation, the erysipelas now affecting only the extremities, the areas previously involved on the trunk and head having healed. On the eighteenth day the erysipelas affecting the upper extremities, which had reached the wrists, cleared. On the nineteenth day the erysipelas about the ankles, which was all that remained, had completely faded. On the twentieth day treatment was stopped, on the twenty-second day the temperature dropped to normal without subsequent rise, and on the twenty-fourth day the patient was discharged cured of her erysipelas. On the twentieth day a blood examination showed 11,000 leucocytes, 72 per cent. polymorphonuclears, 3,900,000 reds and 70 per cent. hæmoglobin. The temperature had fluctuated widely throughout the course of the disease, while the pulse, except for an occasional rise, had generally remained below 100 and had maintained a good volume. The patient was of a short slender type of physique. In this case, as well as in

Cases 5 and 6 of Group IV, in all of which the erysipelas spread for many days, the spread of the erysipelas was slow.

In Case No. 7 of Group IV, A. S., an infant, complicated with malnutrition, the spread was rapid and uncontrollable, and in this patient as well as in Case No. 8 of the same group, C. M., another infant likewise complicated with malnutrition, *exitus lethalis* quickly supervened.

Erysipelas of the Back.—Out of twelve cases in this series of erysipelas involving the back, the erysipelas of the back in eight cases—six adults (Group I, Nos. 48, 49, 58, 59 and 66, and Group II, No. 6) and two children (Group III, No. 8, and Group IV, No. 4)—soon became checked; in one case, a baby (Group IV, No. 5), it spread unchecked with ultimate recovery; and in three cases (Group IV, Nos. 6, 7 and 8), two of whom were malnourished infants and one was a puny baby, it spread unchecked with ultimate death. In Case 48, the erysipelas of the back was controlled while being treated with chinosol ointment, soon after increasing the applications of the latter to once in two hours in the daytime and once in four hours at night. The other five adult cases were treated with ether and the tincture of chinosol. In Case 58 the erysipelas was not controlled while the tincture of chinosol only was being used, but it was controlled shortly after beginning to wash the skin with ether, preceding painting with the tincture of chinosol.

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VON RECKLINGHAUSEN'S DISEASE OR OSTEITIS FIBROSA

WITH REPORT OF A CASE PRESENTING MULTIPLE
CYSTS AND GIANT-CELL TUMORS

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IN the wards of the Philadelphia Hospital there is at the present time a young negress, who presents a most monstrous appearance (Fig. 1). Immense solid bone tumors involve the upper and lower jaws; cystic tumors are present in the right and left humerus; pathological fractures with vicious fibrous union are noted in the right and left femur; there is extreme muscular atrophy; the spine and pelvis are greatly deformed; the X-rays show marked decalcification of the skeleton and osteitis fibrosa. This patient has been in the hospital for a year, during which time the affection has been stationary. She has been bedridden for over four years.

This is a case of Von Recklinghausen's disease, or osteitis fibrosa with multiple bone cysts and giant-cell sarcomata of the epulis type, a disease of bone exceedingly rare in this country, only four or five cases having been reported. As far as could be determined, it is the only case on record in which a member of the colored race has been affected by this peculiar malady.

There are a number of clinical and laboratory findings in this case which would tend to throw some light on the causes of this disease, namely: rickets, tumor of the hypophysis, and severe dental infection. The presence of these three conditions in this patient is manifestly suggestive that the disease could arise in the course of such a combination. The studies on animals by Edward Rehn, and by George Barrie, whose recent contributions upon bone pathology have been enlightening, tend to show endocrine disturbances, low-grade infectious processes, and errors in calcium metabolism in this disease.

S. J., colored, female aged twenty-one years, born in the United States, for the past four years has been bedridden because of fractures of the right and left femur. Within the past five years numerous bone tumors have appeared, involving the jaws and humeri.

Her family history is negative; mother dead, cause unknown; father living and well; no members of this family have had tuberculosis or cancer, nor was there any one affected with deformities of bones or joints.

Previous medical history: She was born at term; normal birth; artificial feeding; started to walk at two years of age. No illness during infancy or childhood. Was well until ten years of age, when she noticed slight knock knee. No treatment was instituted at this time. In 1912, her family moved to New Hampshire, where she lived a year. At this time the deformity of the knees became so bad that it interfered with walking. She attributed this condition to insuffi-

cient food, intense cold, confinement and lack of exercise. In 1913 was operated upon by Dr. A. C. Wood at the Howard Hospital, supracondyloid osteotomy of right and left femur. Was in the hospital six weeks, no apparatus worn after operation. On December 8, 1914, the right femur fractured after a slight fall and was treated at the Hahnemann Hospital. Buck's extension and coaptation splints. On February 17, 1915, it was found that fibrous union existed, the ends of the bones were free. A Lane plate was then applied. At this time the urine was normal, and the X-ray showed the fracture at the junction of the upper and middle third. Both fragments showed cystic degeneration. She was discharged May 13, 1915, apparently with good union.

In the fall of 1915, a molar tooth was extracted from the left lower jaw. Shortly after this a tumor developed in the socket which grew very rapidly, and soon caused a marked expansion of the alveolar process. About three or four weeks after this, pain and stiffness developed in the left shoulder and elbow joints. The upper and lower ends of the humerus began to expand and in the course of six months they were so large as to interfere with the function of the shoulder and elbow. (Fig. 2.) At no time did she have much pain while these tumors were growing. In the early part of 1917, the upper end of the right humerus began to expand, reaching its present size within six months. This tumor has not grown larger since. On February 19, 1918, while standing at the side of a table the left femur fractured spontaneously in its middle. (Fig. 3.) At the Hahnemann Hospital, where she was treated, the records showed the following conditions: old fracture of the right thigh with vicious fibrous union, scoliosis, contraction of the pelvis, swelling of the lower third of left femur and upper third of right femur, expansion of left lower maxilla, extreme muscular atrophy. Röntgenographic examination of the bones involved, showed swelling and deformity, decalcification and replacement of lime salts by fibrous tissue. The opinion expressed by the röntgenologist at this time was osteitis fibrosa of the general type. The Wassermann test was negative, the urine contained albumen and some pus-cells. Blood showed the following: 5600 leucocytes, 3,146,000 erythrocytes, 70 per cent. hæmoglobin, differential count, polymorphonuclears 51 per cent., small lymphocytes 41 per cent., large lymphocytes 6 per cent., transitionals 2 per cent. A section was removed from the left lower jaw for pathological examination, and the report was osteo-sarcoma of the giant-cell variety.

About two years ago the left superior maxillary bone was involved, the tumor which apparently expanded the antrum, grew very rapidly toward the left nasal chamber almost occluding it.

Eighteen months ago the right inferior maxillary bone began to expand and within a period of three months the tumor reached its present size. At no time did she have pain during the growth of these tumors. About a year ago she had frequent and profuse hemorrhages from the mouth. The bleeding came from the swollen gums and ulcers of the hard palate. At present she does not bleed. She has been in bed for four years; rarely complains unless the fractured limbs are disturbed. Appetite is poor, mastication is impaired, has headaches occasionally, and is constipated. She has never menstruated and growth has been arrested since 1912.

Physical Examination.—General: When one views this patient for the first time, he is impressed with the marked deformity of face and upper extremities. The patient lies in bed unable to move without pain. There is a marked degree of muscular wasting. She has a fairly intelligent look, her speech is distinctly nasal in quality, her disposition seems to be docile.

Head: The head is very large and square, and its size is out of all proportion to her body, which is quite small. There are no bony lumps on the skull. The

circumference is thirty-two inches, the length of the face from the symphysis menti to the hairy margin of the forehead is eleven inches. The face is distorted by massive bony tumors of the right and left inferior maxillary bones and by an osteocartilagenous tumor filling the left nasal space and expanding its walls. There is a marked deflection of the septum to the right. Respiration through the nose is possible, but only through the right nostril.

Ears: The ears appear normal. Hearing, however, is markedly diminished on the right side because of the occlusion of the external auditory meatus by the tumor of the right inferior maxilla.

Eyes: The eyes react to light and accommodation. The pupils are equal in size, conjunctiva is negative.

Mouth: The buccal cavity is markedly contracted by the bulging tumors which involve the jaws. The alveolar process of the lower jaw is greatly thickened. It is broad, and the space between the cheek and jaw is practically obliterated. It appears confluent with the cheek. The right inferior maxilla is massive in appearance. It is rough, hard and in certain places nodular; painless to touch. It reaches from the symphysis menti to the temporo-mandibular joint to the malar bone and obliterates the submaxillary space. The inferior maxilla of the left side is also enlarged but not to the same extent as the right one. The hard palate presents a central furrow on each side of which are two convex bulging surfaces. There is an extensive ulcer involving the entire right half of the hard palate. This ulcer bleeds very freely at times. There is a pathologic fracture at about the middle of the horizontal ramus of the right inferior maxilla. Crepitus can be easily elicited. The teeth in the upper and lower jaw are rather small, irregular in size and shape, in places, are covered over by the hypertrophic gingival mucosa. This is bluish red in color, very spongy and bleeds freely when irrigated. There is a soft spongy mass violaceous in color, about the size of a hazel nut, situated posteriorly to the lower incisors, which also bleeds freely at times. This apparently is an epulis. There are numerous ulcerated areas on the gums, a number of teeth show decay and there is marked pyorrhœa alveolaris.

The tongue is negative. An examination of the throat was difficult because of the contracted condition of the mouth. However, nothing was seen either in the pharynx or the tonsils indicating any abnormality. Deglutition is normal.

Neck: The neck is negative.

Thorax: The thorax is small and narrow and shows a marked degree of emaciation. The supra- and infra-clavicular fossæ are depressed. The clavicles show exaggerated curvatures. At the costochondral junction, there is evidence of considerable thickening, producing a characteristic rachitic rosary. The lower costal margins flare out, showing a distinct groove on either side. The intercostal spaces stand out very distinctly as parallel depressed rows. The sternum is prominent, giving the chest the appearance of being pigeon breasted.

Lungs: Respiratory movements are shallow. Both lungs move equally and there appears to be no lagging at either apex. Percussion, negative. Auscultation reveals fine râles at the left apex which is suggestive of pulmonary tuberculosis.

Heart: The heart is negative. The apex beat is in its normal position. No murmurs audible.

Abdomen: The abdomen is large and distended. The liver is felt two finger breadths below the right costal margin. The spleen is not palpable. The lower pole of the left kidney is felt opposite the crest of the ilium. There is some tenderness over the region of the bladder.

Spine: It is difficult to examine the spine because the patient cannot be made to sit up. With the patient lying on her side, there is noted a kyphosis in the

upper dorsal region. There is also a slight lumbar scoliosis to the right. The spinal muscles are atrophic.

Pelvis: The pelvis is distorted and greatly contracted. The distance between the anterior superior spines is 23 cm. and the anterior posterior diameter is 15 cm. There is some tilting of the right ilium upward.

Extremities: The left humerus is hour-glass in shape with two bulbous expansions appearing at either end of the bone. The upper end of the left humerus is rough and irregular. It is somewhat fusiform in shape. The expansion of this end of the humerus interferes with the movement of the shoulder-joint and abduction is limited to about ninety degrees. The tumor is painless. The lower end of the humerus is globular in shape and the tumor encroaches into the elbow-joint. The elbow cannot be extended beyond a right angle.

The tumor is eleven inches in circumference. It is hard and rough on the outer surface but it crepitates on pressure on the inner surface. The growth of the left arm apparently has been arrested. It measures eighteen and a half cm. while the forearm is twenty-three and a half cm.

The upper end of the right humerus presents an irregular, hard, nodular tumor, which encroaches into the shoulder-joint. There is some outward bowing of this bone. The right humerus measures sixteen and a half cm. and the right forearm twenty-three and a half cm. There is also some limitation of movement on abduction of the right arm.

The radius and ulna appear to be normal in size and shape, no bony tumors being in evidence. A striking deformity is noted in the terminal phalanges of all fingers. There is a dorsal curvature of all these bones. When the fingers are extended, these phalanges are almost at right angles to the fingers. The nails partake in this curvature and they curl backward. They are claw-like in appearance. (Fig. 4.)

Lower extremities: Both thighs are deformed. About the middle of the left thigh, there is an acute angulation with the apex of the angle inward. The leg is everted. The left thigh is swollen and painful when motion is attempted. There is an extensive infiltration about the middle of the left femur. Flexion and extension of the left knee is possible but limited, owing to the pain that is induced at the site of the old fracture. Motion at the left hip could not be elicited. The right femur is dislocated upwards and backwards. In the region of the great trochanter, there can be observed a rectangular projection about two inches long and one-half inch wide, which lies obliquely upon the upper and external aspect of the thigh. This apparently is the plate that was inserted several years ago, the ends of which appear very superficial, almost underneath the skin. There is some motion at the site of this fracture.

Both knee-joints appear enlarged, a slight degree of motion is present, adhesions within the joints, and fibrotic hypertrophy of the surrounding soft structures prevent a normal range of motion. Both legs and feet present no deformities. On the anterior surface of the left tibia a number of elevated areas are noted. These are soft tender swellings, non-inflammatory, probably subperiosteal hemorrhages. The bones of the legs are normal in length.

Genitalia and nervous system are negative.

Laboratory examinations.—Urine, specific gravity 1010, color white, albumen trace, no sugar, no Bence-Jones bodies, leucocytes, no casts.

Blood.—Hæmoglobin 55 per cent., leucocytes 10700, erythrocytes 1,370,000 polymorphonuclears 55 per cent., small lymphocytes 40 per cent., transitionals 40 per cent., basophiles 40 per cent.

VON RECKLINGHAUSEN'S DISEASE

Quantative Analysis of the Two Samples of Urine:—

	7-15-21		7-22-21
Volume	1630	cc.	1200
Sp. gr.	15		18
Solids	64	g.	56
Reaction	70	cc.	neutral
	<hr/>		
	N/10	NaOH	
Tot. N.	3.95	g.	3.84
NH N		g.	1.09
			<hr/>
Creatinin	231	mg.	240
Creatin		mg.	240
			<hr/>
Uric acid		mg.	325
NaCl	6.3	g.	4.8
P .....	.49	g.	.51
CaO .....	.206	g.	.188
MgO .....	.098	g.	.083
S .....	.256	g.	.265

Chemical Examination of the Blood:—

Urea N.	10	mg.	per	100	c.c.b.
Creatinin U.	102	mg.	per	100	c.c.b.
Uric acid	4.6	mg.	per	100	c.c.b.
Sugar	109	mg.	per	100	c.c.b.
Chloride	660	mg.	per	100	c.c.b.
Nonprotein N.:	25				

Radiographic Examination by Dr. E. Burvill-Holmes, Röntgenologist of Philadelphia Hospital.

Left Elbow: There is considerable enlargement of the bone with marked thinning of the compact tissue and the presence of trabeculae. No definite cystic formation can be demonstrated.

Femur: The left femur shows a pathological fracture at the middle and upper third, with formation of false joint. The latter is also noted in the soft tissues by a definite fold over the site of fracture. The compact tissue is here thinned also, although the bone shows no enlargement. In fact, the bone is under-developed. Few trabeculae are demonstrable about the head of the bone but none in the shaft. There is a definite mottling of the cancellous tissue. The hip is dislocated. The right femur is similar to the left, a fracture being present about the neck of the bone. A plating operation has been performed, the plate still being in the situ. No callous formation. The head and neck are rarefied and the head is dislocated downward.

Hands: A peculiar claw-like distal phalanx is seen. There is enlargement of the second phalanx of the index finger with thinning of the compact tissue. A suggestion of a similar condition exists in the second phalanx of the adjoining finger.

Skull: Bone detail is lost in both maxillae. These bones are swollen and have a roughened putty-like appearance. The teeth have no real bony support and there are many apical abscesses. Delay is also evident in the eruption of the third molars. A pathological fracture is demonstrable on both the left and right mandibles at the neck of the bone and a definite cystic condition exists. The outer plate of the skull is roughened and markedly thickened and has a blurred appearance, similar, but of course to a much lesser extent, to that seen in cases

of osteitis deformans. The sella turcica is elongated, the floor is thin and the posterior clinoid process is pushed upward, suggestive of hypophyseal tumor.

Diagnosis: Osteitis fibrosa. We are of the opinion, however, that a second pathological condition is existent in the maxilla-new growth, the nature of which is indefinite.

Osteitis fibrosa is an interesting disease of bone, first described in 1891 by Von Recklinghausen. He differentiated this disease from osteomalacia by demonstrating the presence of calcium absorption and fibrous metaplasia. He showed that the pathologic changes within the bone and marrow were the results of chronic inflammation. The formation of fibrous tissue, bone cysts, and giant-cell tumors, within the bone are various phases of this affection.

Two types of this disease are recognized, a local and a general form, the former being far more frequent in occurrence. Bloodgood, in 1910, collected sixty-nine cases, twelve of which he considered general osteitis fibrosa. Silver, in 1912, collected ninety-seven cases from various sources, seventeen of which were of the general type. Elmslie, in a comprehensive monogram on this disease, fails to mention any personal experience with the general form, but reports six cases abstracted from foreign literature. Cases of the generalized form of osteitis fibrosa have been reported by Percy, Hausling and Martland, DaCosta, Funk, Bergheim and Hawk, Crile and Hill, Willard and Andrus, and Barrie. Case reports of this disease in the foreign literature are quite numerous, only two of which will be briefly abstracted because they are so strikingly similar to our case. Rehn reported a case in a young woman aged twenty-four years, whose disease began with an epulis of the lower jaw, when she was eleven years old. Ten years later, when again observed, she had a large giant-cell sarcoma of the upper jaw with characteristic changes of osteitis fibrosa and cysts throughout numerous bones of her body. Von Haberer recorded a case in a boy thirteen years old, who first presented a tumor of the lower jaw in the third year, spontaneous fracture of the right femur in the fifth and eighth year, both uniting. There was a cystic expansion of the upper part of the shaft of the right humerus and the middle of the shaft of the right tibia.

Etiology.—Numerous theories have been advanced by different observers as to the cause or causes of this obscure affection. Virchow thought that the cystic degeneration was due to absorption of enchondromata. Boit believes that the changes in the bones result from toxic metabolic or infectious processes and derangement of internal secretions. In an interesting comparative study, he shows that leontiasis ossea and osteitis fibrosa are identical histologically. Lubarsh and Rapke believe that the disease is an infectious one and they have found organisms in the contents of the cysts. Von Mikulicz stated that osteitis fibrosa results from a perverted growth of bone and marrow, the balance between bone formation and absorption being disturbed, the osteoclasts taking on excessive function and the connective-tissue elements in the marrow developing to an extreme degree. Rehn has shown that the changes in the facial and nasal bones in animals suffering from



FIG. 1.—Osteitis fibrosa with giant-celled sarcomata.



FIG. 2A.—Osteitis fibrosa showing sarcomata of humerus.



FIG. 3. —Osteitis fibrosa showing spontaneous fracture of femur.



FIG. 3b. —Osteitis fibrosa showing sarcomatous of humerus.



FIG. 4.—Osteitis fibrosa showing phalangeal changes.

osteitis fibrosa are much the same as those observed in man. In swine he has observed that the changes are apparently caused by an inflammatory process starting about the teeth. This observation seems to correspond rather closely with the findings in our case.

The nature of this type of bone disease is intimately bound up with some grave nutritional disturbance, in which calcification of one bone is retarded. A severe form of rickets may be considered a predisposing cause of this affection. McCrudden states that in severe rickets not only may the blood fail to supply lime salts to parts of the bone which should calcify, but the bone may be destroyed which has already been calcified and lay down osteoid tissue instead, and in this sense it may resemble osteomalacia. Inflammation of the immature bone and marrow can be followed by fibrous metaplasia.

Not all cases of rickets develop osteitis fibrosa, but if there be some additional factors, such as infectious processes and endocrinal disturbances, it is likely that osteitis fibrosa may develop. The chronicity of the affection indicates that the product of these infectious agents are of low toxicity, tuberculosis, syphilis or pyogenic diseases of low type, for instance.

Barrie has shown in a recent contribution the relationship which exists between these various causative elements and the production of hemorrhagic osteomyelitis. In a comparative study of osteitis fibrosa and hemorrhagic osteomyelitis and fibrocystic osteomyelitis, there appears to be a close identity between them etiologically and histologically.

Traumatism does not cause the general form of this disease, although there is distinct evidence to show that local osteitis fibrosa and benign bone cysts are caused by trauma.

Pathology.—There is defective calcification of the bones, which leads to thickening, weakening and deformity of one or many bones of the limbs, jaws, skull or trunk. The process is a general one, in which bone is replaced by cellular fibrous tissue, which may either start in the marrow, replacing it, or the fibrotic metaplasia may begin in the cancellous substance of the bone and later invade the medullary cavity. The formation of bone cysts is produced by a liquefaction of the fibrous tissue, or giant-cell sarcomata, usually of the epulis type, may develop in these areas of metaplasia. The bone is distended and partitioned off by trabeculae, the contents consisting for the most part of fibrous connective tissue. In the walls of the cysts may be found giant cells in great numbers.

The presence of these cells and their significance in this disease has caused considerable controversy in the past. According to Ewing, Hektoen, Mallory and Barrie, these cells are not malignant. They may be found in bone which is undergoing a reparative process. They are very large cells and contain many nuclei; they are closely allied to the giant epithelioid cells found in inflammatory regions, and their function is to act as scavengers, carrying away detritus.

Some consider these cells large osteoclasts whose normal habitat is in

Howship's lacunæ and whose presence in large numbers in the walls of these bone tumors is called forth by some unknown irritant.

The long pipe bones, such as the femur, humerus, tibia, are most frequently affected. The disease starting at the extremities of these bones extends upward affecting the shaft, and distending it. The expansion as a rule is oval and sometimes globular. Rarely is the cortex broken through. The epiphysial cartilage may be invaded, causing an arrest in the growth of bone. In one case the epiphysial cartilages of both humeri were destroyed, producing a marked shortening of these bones. The joints are rarely invaded, although the proximity of the expanded tumors near the ends of the bones interferes considerably with their function.

The contents of these cysts may be serous if the disease has existed for a long time. In an earlier stage of the process the content simulates currant jelly; sometimes it is gelatinous and chocolate brown. The tissue within the excavated bone may resemble exuberant granulations. Sometimes hemorrhage from these tumors is very profuse, when an opening is made in them. There may be a thick lining membrane of fibrous connective tissue around the cyst and in other instances there is no membrane. The periosteum is not thickened and the bone is uniformly rarefied and shows the characteristic trabeculation. The end results of this generalized condition is fibrosis of bone. As in tuberculosis of bone the striking feature is the formation of fibrous connective tissue in which the regeneration of bone takes place, only to a very limited extent, if at all.

Symptoms.—The clinical course of this affection begins insidiously in the young child or adolescent. The child may complain of vague rheumatic pain in the extremities. The patients may consult their physician for some secondary manifestation of this disease, such as knock-knee or bow-legs or pes valgus. Usually until some accident calls attention to the condition, it is apt to be overlooked. Fractures of the bones are very common and they usually result from some trivial injury or are spontaneous. Bones unite very slowly, and sometimes fibrous union results. Quite early in the disease, tumors appear at the ends of the long bones and the bones of the face. These tumors make their appearance suddenly, grow rapidly for a while, and then their progress is arrested. Owing to the softening of bone, deformities of spine and pelvis are quite marked. During the course of the disease pain is not a leading symptom. There is considerable muscular atrophy, and these patients are very often bedridden for months and years. Hemorrhages may occur from the mouth and nose. Dental caries and pyorrhea alveolaris of severe types may be present. The presence of these tumors in the bones of the maxilla interferes with mastication.

The X-ray findings are quite characteristic and are distinctly diagnostic of the affection. The bone is expanded and the affected area is extensively subdivided by trabeculæ, the cortex is thinned, well marked and regular. There is no sclerosis of the surrounding bone nor thickening of the periosteum. The expansion is egg-shaped, and it gives one the impression of

having started from the middle and spread equally in all directions. The appearance of those tumors which represent an earlier stage of the disease cannot be made out definitely by the X-ray. There is expansion of bone but trabeculation is not present. Fine bone detail cannot be made out, the bone has the appearance of putty with here and there a light space, which may indicate normal bone. The blood findings in these cases show a marked reduction in the hæmoglobin and red cells. The red-cell count may be as low as a million or less, because of the destruction of the bone-marrow. There is usually increase in the magnesium and calcium content of the plasma, indicating that the bones are unable to utilize these mineral salts.

The urine may contain albumen and casts. Bence-Jones bodies are not found. Quantitatively there is an increase in output of phosphorus and calcium, and creatin. The course of this disease is from eighteen months to eighteen years, and death usually occurs from cachexia or intercurrent disease.

The diagnosis is based upon the following: Occurrence of multiple spontaneous fractures, which rarely unite normally, associated with tumors, which involve numerous bones of the body, by the slow progress of the disease, beginning in childhood or early adolescence, and by the characteristic X-ray findings. These cases are often mistaken for sarcomata or osteochondromata. A pathologic examination of a specimen will then show the characteristic fibrotic change in the bone and the peculiar giant-cell content.

The prognosis in a case of this character is uniformly bad. Nothing in the way of a cure is known. Our patient has had the benefit of a course of radium and X-ray without any effect upon the course of the disease. She has been treated internally with phosphorus, calcium, arsenic, pituitary and thymus gland extracts without any apparent benefit to her. Surgical treatment can be applied in the treatment of the fractures and to the bone cysts if they be accessible. But these measures result in failure quite often. However, in the local form of the disease, curettage and implantation of a bone graft promptly cure the condition.

CONCLUSIONS

1. Osteitis fibrosa, under which may be included benign bone cysts, giant-cell sarcoma of the epulis type, hemorrhagic osteomyelitis and the generalized form (Von Recklinghausen's disease) is a distinct pathologic entity characterized by a fibrous metaplasia of bone.

2. Two types of the disease are recognized: a local and a general type. Local osteitis fibrosa and benign bone cysts are dependent upon trauma in a great majority of instances. The general form is dependent upon grave nutritional disturbances. Endocrinal glandular dysfunction, faulty calcium metabolism and chronic infection of a low grade seem to be of etiologic significance.

3. Cysts, osteitis fibrosa cystica and giant cells may occur in the same bone. The giant-cell content is not prognostic of malignancy.

4. Diagnosis of osteitis fibrosa is based upon the long duration of this process with very vague symptomatology, the frequency of spontaneous fractures and upon X-ray examination. Very often microscopic examination of pathologic sections is necessary to clear up the diagnosis.

5. The local form of the disease is benefited by curettage and bone transplant. The type showing multiple lesions must be given constitutional treatment directed toward the underlying constitutional disturbance. If the lesions be accessible, curettage and bone transplant may be employed. The X-ray and radium have been used in these cases with some success.

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NEURO-FIBRO-MYXOMA TREATED BY CONSERVATIVE OPERATION

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FROM THE SURGICAL CLINIC OF THE ROBERT W. LONG HOSPITAL

CASE reports of single tumors of the larger nerves are so few that our knowledge of the clinical behavior of these growths after operation is rather scanty. The surgeon at the time of the operation seems often to have been in doubt in regard to the benign or malignant character of the tumor. He therefore has not known exactly how radical a removal of the growth is required. It seems to us after careful study of the microscopic structure of the two tumors considered in this paper, that even this method may fail to be conclusive, since we encountered many fields (see Figs. 3 and 5) which are decidedly sarcomatous in appearance. Yet the clinical results show that both tumors were benign.

CASE I.—Mr. H. D., age forty-two, white, was admitted to the Robert W. Long Hospital, December 30, 1915, with the complaint of a "tender knot" above and behind the collar-bone.

Family History: Father died of carcinoma and diabetes. Five other blood relatives died of diabetes. Otherwise negative.

Past Personal History: General health always good. No serious illness except frequent "colds." He had had no surgical operations except incision of an upper cervical lymph-node which had suppurated. This was found not to have any connection with the present condition.

General History: Gonorrhœa at age of nineteen without complications and sequelæ. Married ten years; wife never pregnant. Wassermann negative.

Present Condition: Upper cervical lymph-node removed twelve years ago. One year later a small tumor was noticed behind and above the collar-bone on the left side. This was painful only on examination. Later his collar irritated the tumor by its constant pressure, giving a sensation not unlike that produced by pressure on the "crazy bone." The lump was about as large as a small hazelnut. There was a gradual increase in size until last year when it reached the size of an English walnut. It has doubled in size during the past year and is now about the size of a hen's egg. Since the rapid increase in size, besides the sensation imparted by the tumor mass, there has been almost continuous pain in the shoulder region.

Examination showed a man apparently in good health and well nourished. There was a tumor in the cervical region situated about 1 cm. anterior to the anterior border of the left trapezius and just above and behind the clavicle. The tumor was oblong and about 2 cm. in diameter; was smooth and not attached to the skin and moved fairly freely

over the underlying structures. There was no pulsation. It was crossed transversely from below and behind, upward and inward by a cord-like structure, probably the omohyoid. There was no motor disturbance of the arm or shoulder and no sensory disturbance except the pain before mentioned in the shoulder region; no generalized lymphadenitis.

The heart and lungs were negative except for a slight systolic murmur at the apex which was not transmitted. Urinalysis negative, except for a very faint trace of albumin. Leucocyte count, 7000; hæmoglobin, 90 per cent. Diagnosis: Benign tumor of the nerve sheath.

Operation by Dr. W. D. Gatch, December 31, 1915. The operation was started with local anæsthesia, but the tumor was so painful and adherent to the outer cord of the brachial plexus that general anæsthesia was resorted to. Two large nerve trunks were dissected from the tumor mass. The surrounding tissues were freed and the tumor peeled out. A frozen section was immediately made, which appeared somewhat sarcomatous in character, but it was deemed advisable to do nothing more radical. One small rubber drain was inserted and the skin closed with plain silk. The patient made an uneventful recovery and was discharged January 4, 1916, the wound having healed by primary intention.

The gross specimen lab. No. 710 has an oblong shape. After being preserved in formalin, it measures 5 cm. long by 3 cm. wide and $1\frac{1}{2}$ cm. thick. It is oblong in shape and somewhat flat. The specimen at one pole is rather firm, at the other soft and of a grayish-white color. On cutting no little resistance is offered. On holding a specimen up to the light and looking through a thin section there is seen to be a dense area between which are areas of thin transparent-like tissue. The tumor has on one side a smooth contour. On the side proximal to the nerve trunk is a somewhat ragged surface where it was adherent to the nerve sheaths.

Microscopic Section: The tissue is essentially fibrous and myxomatous in character, chiefly the former. The fibrous tissue is for the most part very dense (see Fig. 1). Here the cells are comparatively few in number and the connective-tissue bands very wavy and crowded together. The blood-vessel walls in such an area are very thick and dense and take a homogeneous eosin stain and appear to be hyaline in character. There is practically no nuclear material in these vessel walls, and the walls are without elastic tissue. The vessels do not have the appearance of being congested.

Such an area in places blends into another area which has a distinct myxomatous character (see Fig. 2). Here the tissue substance tends to have a more homogeneous appearance and contains but few fibrous tissue bands. The cells are somewhat stellate or elongated. In places there are a good many blood-cells scattered about the fibrous bands. The blood-vessels in such an area contain more blood. This has the appearance of a small hemorrhagic area.

There are small areas in the vicinity of a blood-vessel in which the tissue seems more cellular with rather thin-walled blood-vessels and

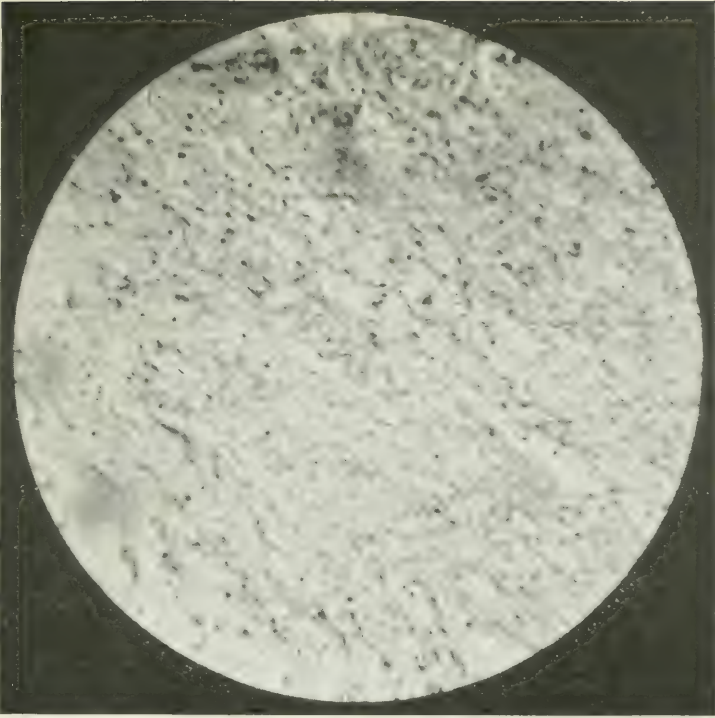


FIG. 1. Photomicrograph. Showing a dense fibrous area. Note the wavy fibrous tissue.

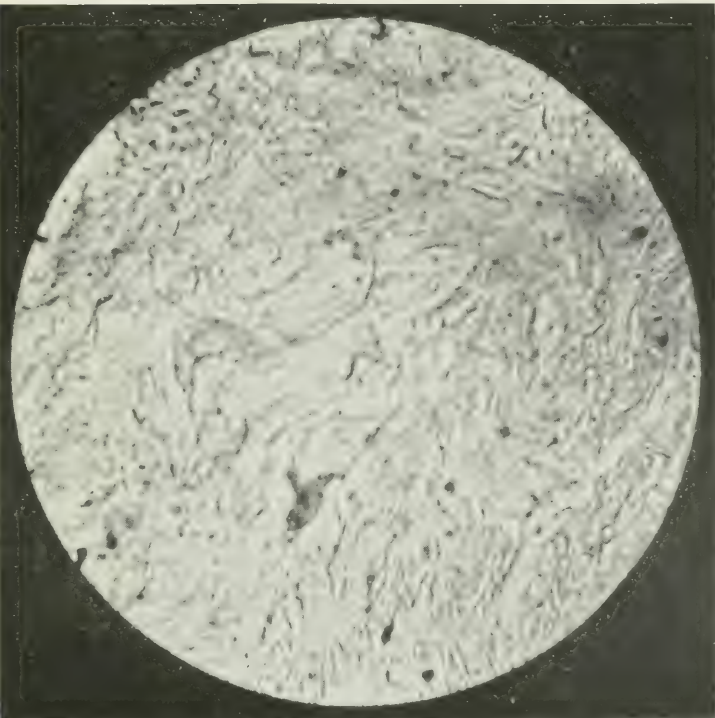


FIG. 2. Photomicrograph of Case I showing area of myxomatous tissue.

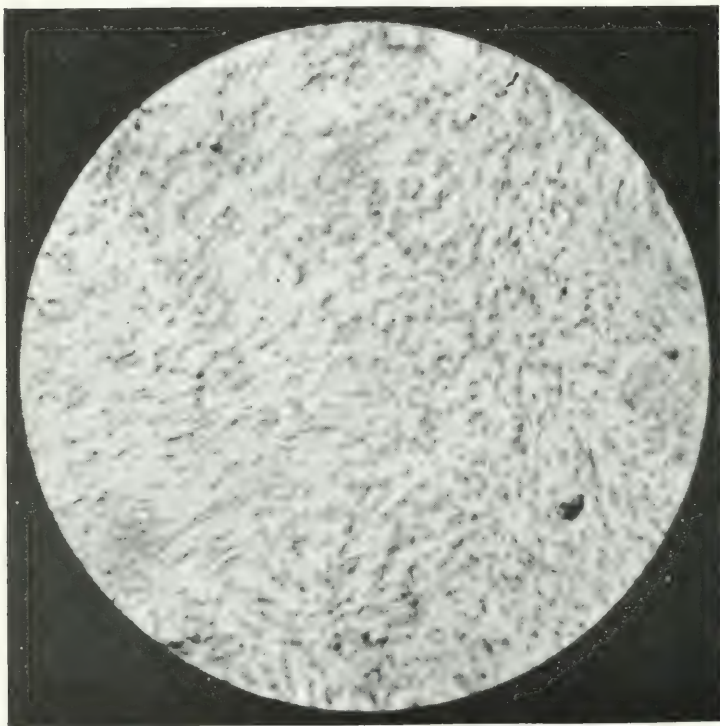


FIG. 3.—Photomicrograph Case I. Showing the very cellular area very much resembling sarcoma.

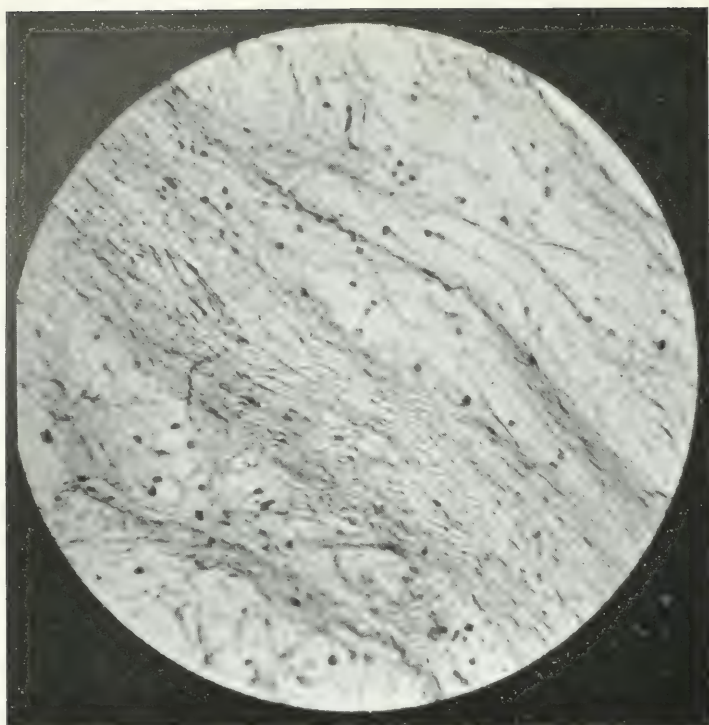


FIG. 4.—Photomicrograph of tissue Case II. Note band of dense fibrous tissue. Note also stellate nuclei or myxomatous tissue on either side.



FIG. 5.—Photomicrograph of Case II, showing areas of myxomatous tissue. Note tendency to cellular areas and absence of fibrous tissue.

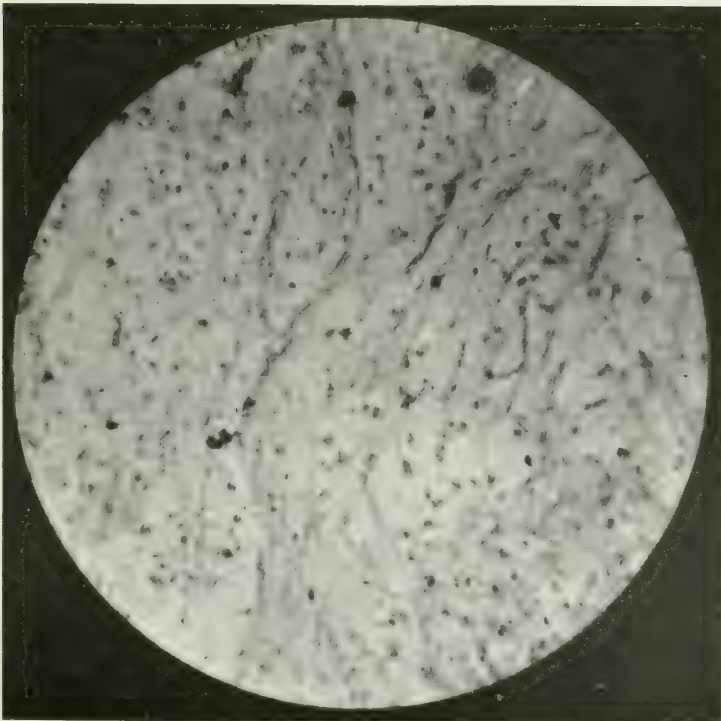


FIG. 6.—Photomicrograph Case II, showing another area of myxomatous tissue. Note vtrnls and the stellate nuclei.

an occasional mitotic figure. This was suggestive in the frozen section of a sarcomatous condition (see Fig. 3), but is not marked enough to be classed as such, and besides the clinical course of the case would practically rule out malignancy. No suggestion of any nerve tissue whatever was found in this section.

From the clinical picture and course and the pathological examination this tumor is to be classed as a false neuroma of the class neuro-fibro-myxoma, the fibrous tissue predominating.

CASE II.—A Mr. G. P., age forty-eight, white, was admitted to the Robert W. Long Hospital, January 12, 1916, complaining of a tumor in the right side of the neck. The tumor was present ten or twelve years ago. About two months ago the tumor gradually increased to the size of a goose egg and then slowly decreased to the size of a large hen's egg. Recently the patient has had a pain in the right scapular region and down the right arm. He described a tingling sensation in the fingers, giving very much the same sensation as being struck on the "crazy bone."

On examination there is a spindle-shaped tumor situated in the right side of the neck parallel to and beneath and anterior to the border of the trapezius muscle. The mass extends upward to the posterior border of the sternomastoid muscle at its mid-point and downward to the clavicle at the junction of the same with the trapezius. The tumor is firm, smooth, and not attached to the skin, but somewhat attached to the underlying structure. Other history and examination unimportant. Diagnosis: Solid tumor, either fibroma or myxofibroma, in contact with the superior part of the brachial plexus.

Operation January 17, 1916, by Dr. W. D. Gatch. Incision over the site of the tumor. The upper part of the tumor was dissected out. The lower part of the tumor was jelly like in consistency. Myxomatous material was found in a pocket which extended under the right clavicle and into the right axilla. This pocket was swabbed out with one per cent. iodine solution. One small gauze drain was inserted and the skin closed with silk. Recovery was uneventful and the patient was discharged January 26, 1916. Wound healed by primary intention and there was no motor or sensory disturbance in the affected side.

Specimen lab. No. 727. This tumor was from external appearance not very large, but at operation was found to be very extensive. It could not be enucleated as the other was. The upper portion, which was chiefly fibrous, was removed rather easily, but it was found to extend behind the clavicle down into the right axilla. This was removed piecemeal as far as possible. At the extreme distal extremity the tissue was so soft and gelatinous that it was almost entirely without body and had to be removed by swabbing it out with a sponge. On examination of the tissue from the proximal pole, it was found to be fibrous and to cut with considerable resistance. The lower pole resembled in substance Wharton's jelly.

On section, the tissue from the upper pole is found to be fibrous, and is dense, the bands of fibrous tissue being wavy and closely packed together with very long, curved nuclei, few in number (see Fig. 4).

Some of this has lost its fibrous character and has become homogeneous and hyaline. Toward the distal extremity the cellular material is still scant, but the picture is that of myxomatous tissue (see Figs. 5 and 6). The blood-vessel walls are thin. This must be regarded as a neuro-fibro-myxoma, in which the myxomatous tissue predominates.

General Discussion.—False neuromata are classed under the term neuromata, though their connective-tissue origin is apparent. Virchow, in his classification in 1863 in the *Die Geschwulste*, says that true neuromata do occur, but rarely, and then occur only in the sympathetic system. Von Recklinghausen regarded these various false neuromata as having histological unity and as being but different manifestations of essentially the same pathological changes in the nerve constituents. Heredity in the multiple neuromata is considered to play a very important rôle. Flemming and Marvin have recently reported three cases of false neuroma of the localized type which occurred in the same family. The hereditary tendency has not been noted in this type before. One of the two cases reported in this paper gave a history of having carcinoma in the family, but no neuromata. The framework of nerve tissue is connective tissue and may give rise to the same sort of tumors as it does elsewhere. These tumors are usually fibromata or myxomata, or a combination of the two. These may undergo degeneration, and become cystic or hemorrhagic. They usually develop slowly and occur far more frequently during middle life. There is a tendency to marked sensitiveness in the tumor mass itself. Trauma is said to be an important etiological factor. Both heredity and trauma as etiological factors are lacking in these two cases.

Various authors believe that benign fibrous or fibro-myxomatous tumors of nerve sheaths may undergo a malignant degeneration into sarcoma. It would seem to the writers of this article that the safest criteria of judging at the operating table, whether a single tumor of a nerve is malignant or not, are the following:

1. The duration of the tumor. If the tumor is of long duration, it is of course not likely to be malignant. Case I shows that even a sudden and rapid increase in size of a tumor which has been quiescent for years is not proof positive of malignancy.
2. The presence or absence of motor or sensory paralysis. This is a most valuable point. A nerve will withstand really a remarkable amount of stretching or pulling from a benign growth, but is quickly destroyed by the infiltration of its substance by a sarcoma. In both of our cases pain and the various other sensory disturbances were the only symptoms produced by the tumors.
3. The gross appearance of the growth when exposed. Case II shows that it may be possible to remove a pure myxoma of the sheath by simply wiping it away. The encapsulation of the fibrous portion of the tumor and the possibility of shelling the same from the centre of a nerve trunk would

seem to be strong evidence of a benign growth, as is the lack of encapsulation with fixation of the growth to the contiguous structures strong evidence for sarcoma.

4. Our experience with these cases leads us to regard the microscopic study of the tumor, especially if such study is relied upon to the exclusion of other evidence, as apt to be misleading.

If after consideration of all evidence available the surgeon is still in doubt as to the nature of the growth, it is perhaps wisest to be conservative, especially if the growth is in a situation where its complete removal is difficult.

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RUPTURED SPLEEN*

WITH REPORT OF THREE CASES

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IN reporting these cases we wish to emphasize the fact that two of the men had spontaneous rupture, of normal spleens, so far as could be demonstrated by macroscopic and microscopic examination and careful history excluding malaria and other diseases likely to affect the spleen. The third case was from trauma. All cases showed similar symptoms and Case II was diagnosed by Major Francis and Case III by Colonel Metcalfe before operation. So sure were we of the condition to be encountered, that a high left rectus incision was made, and a splenectomy performed with recovery in each case. After detailing the cases we wish to briefly review the literature on the subject.

CASE I.—R. F. Sergeant, Co. "K," 14th Cavalry. Age twenty-one. White. Male. Two and three-twelfths years service. Born in Texas. Occupation farmer. Denied ever having used alcoholics.

Previous Personal History: Measles and pertussis in childhood. Influenza and pneumonia in October, 1918. Never any injuries or accidents. Denies venereal infection.

July 28, 1919, shortly after returning from morning drill at Fort Sam Houston, Texas, patient noticed a sudden severe pain in left side of abdomen. Had nausea and vomited twice. Brought direct to Hospital. Admitted to Hospital at 12:00 noon, July 28, 1919. Temperature 96.2, pulse 78 and very weak. Patient appeared in shock, pale and extremities cold. Patient suffering severe pain in left side of abdomen just opposite to umbilicus. At 4:30 P.M., same date, pain in left upper abdomen, paroxysmal in character. Maximum pain just to left of umbilicus. Temperature 99.9° rectal. Leucocyte count 25,000. Examination showed marked tenderness across upper abdomen, rather more marked to the left of mid line. No definite rigidity and no distention. More pain on inspiration and on moving. No urinary symptoms and no previous gastric symptoms. Patient examined by Major Francis about 4:30 P.M. The most prominent symptom noted was pain in left upper abdomen, radiating to left shoulder. Tenderness over left upper abdomen. Patient mentally bright and alert. No other pathology found. Exploratory laparotomy at 6:10 P.M., July 28, 1919. Peritoneal cavity full of free blood. Spleen found ruptured and was removed. Abdomen closed without drain-

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RUPTURED SPLEEN

age. Operated by Major Erdman. Patient made uneventful recovery. Wassermann and urine examination negative.

CASE II.—J.F. Private, 12th Field Artillery. White. Twenty-one years of age. Soldier. Six months service. Family history negative. Previous personal history diseases of childhood only. No serious illness or injuries.

Patient while on stable police with other soldiers morning of June 3, 1921, became very thirsty and was not permitted to leave work to get a drink until later, when he drank a large quantity of cold water; soon afterwards he developed cramp-like pain in abdomen and felt dizzy; told sergeant in charge he was sick and was told to go to quarters. Was walking to quarters some distance away when patient states that he fainted but was soon able to proceed to quarters. Had pain in abdomen and left shoulder. Was seen by Medical Officer and sent to hospital as appendicitis suspect at 8:15 P.M. Examination of patient at receiving ward was negative for appendicitis and he was admitted to General Medical Ward and given routine treatment.

Morning of June 4th, patient up and around ward, but says he feels dizzy and has a little pain in abdomen. At 4:00 P.M. nurse's attention was called to patient now in bed, suffering intense pain in abdomen. Seen at once by Captain Fletcher and found to be in state of severe shock. Temperature 96, pulse 140, skin cold and moist. Presenting picture of hemorrhage. Had constant desire to evacuate his bowels, passing small dark-colored stools, no blood. Abdomen showed no distention or rigidity. Some dullness in sides of abdomen. Patient given 1000 c.c. of ten per cent. glucose solution intravenously. At 9:00 P.M. pulse 150, but good volume, given stimulants during night. The following morning, June 5th, general condition was slightly improved over evening, temperature 99, pulse 120. Still complaining of pain in abdomen and left shoulder. Abdomen showed more apparent dullness but no distention or rigidity. Condition of shock improved sufficiently to warrant operation. Operated 11:00 A.M. Left rectus, high incision. Abdominal cavity full of blood with large clot surrounding spleen. Rupture of dorsal surface of spleen. Spleen and blood clots removed. Cavity filled with normal saline and closed, without drainage. Operated by Colonel Metcalfe. Uneventful recovery.

CASE III.—M.T. Private, Co. "D," 3rd M.R.Bn. Age twenty-two. White. Four years' service. Birthplace Missouri.

Previous Personal History: Patient had measles when small. Never had any serious illness. Right forearm fractured in 1915, good recovery. Venereal history, denied.

On July 6, 1921 about 4 P.M. he was riding a motorcycle on race track preparing for the motorcycle races to be held on July 23rd. He was thrown from his machine, due to machine leaving the track and going over a bank. The patient was brought to this hospital at 6 P.M. same day. Had multiple small lacerations over face, hands and back. Complained of severe pain in left shoulder. Examination of shoulder negative. Abdomen board like rigidity throughout, evidence of small amount of free fluid in peritoneal cavity. Patient's pulse good volume, rate 96, respiration normal. General condition good. Watched until following day, when patient's only complaint was pain in left shoulder. Abdomen tender and rigid with some free fluid present. Diagnosis of ruptured spleen made and patient operated on 6 P.M., July 7th. High left rectus incision. Free blood in peritoneal cavity. Spleen showed transverse and stellate laceration. Spleen removed, abdominal cavity freed of blood clots, normal saline introduced, closed without drainage. Operated by Colonel Metcalfe. Recovery uneventful. Duty, August 12, 1921.

METCALFE AND FLETCHER

BLOOD PICTURE FOLLOWING SPLENECTOMY—R. F. CASE I.

	July 28.	August 4.	August 5.	August 6.	August 24.
Red Corpuscles		4,320,000			4,460,000
White Corpuscles	15,250	17,550	17,050	14,600	11,950
Hæmoglobin, Per cent.		80%			80%
Differential Count					
Small Mononuclears	15	23	15	13.5	20
Large Mononuclears	2		8.5	9.5	10
Transitionals		4	4	3.5	2
Polymorphonuclears	83	73	74.5	73.5	68
Eosinophiles		4	4	2	1
Neutrophiles	83	69	70.5	71	67
Basophiles			0	0.5	

BLOOD EXAMINATION FOLLOWING SPLENECTOMY, CASE III

M.T. Private., Co. "L", 3rd M.R. Bn.

	July, 11, 1921.	July 14, 1921.	July 16, 1921.	July 18, 1921.
Red Corpuscles	4,450,000	3,740,000	4,280,000	4,130,000
White Corpuscles	14,300	35,150	19,050	13,350
Hæmoglobin, Per cent.	85	80	85	85
Differential Count				
Small Mononuclears	19	7	11	20
Large Mononuclears	4	0	4	1
Transitionals	6	3	10	18
Polymorphonuclears	70	90	75	64
Eosinophiles	6		4	2
Neutrophiles	65		70	62
Basophiles	0	0	1	0
	July 19, 1921.	July 23, 1921.	July 25, 1921.	Aug. 9, 1921.
Red Corpuscles	5,333,000	4,700,000	4,730,000	3,290,000
White Corpuscles	12,050	8,600	17,050	8,350
Hæmoglobin, Per cent.	85	85	85	85
Differential Count				
Small Mononuclears	25	27	18	32
Large Mononuclears	4	1	2	8
Transitionals	6	7	5	5
Polymorphonuclears	65	65	75	55
Eosinophiles	6	4	2	0
Neutrophiles	56	60	73	0
Basophiles	3	1	0	0

Commenting on the foregoing cases, it is interesting to note that two patients were twenty-one and one twenty-two years of age, young, healthy, robust soldiers. Without history of previous serious illness or injuries. Cases I and II were spontaneous ruptures and Case III followed trauma, but each showing symptoms of intra-abdominal hemorrhage, dizziness, faintness, shock, nausea and vomiting, some abdominal pain and tenderness, rigidity, marked in one case and slight in two, slight dulness in lower flank when turned on side, the tossing about of the patient, which is not present in ruptured bowel.

Each case was very restless and had what seems to us as almost a pathognomonic symptom, severe pain radiating to left shoulder, and in each

instance the patient complained bitterly of this shoulder pain and when recovered from the anæsthetic remarked upon the relief of this left shoulder pain.

Case No. II, who had the dizzy and fainting spell, no doubt had a subcapsular hemorrhage sufficient to cause the faintness. Then he recovered from this and later from the intracapsular pressure, the capsule was ruptured and then he had his second spell of shock and revived by glucose injection sufficient for operation. In Volume I, *Sajous Analytic Cyclopedia of Practical Medicine*, he quotes that malarial spleens are more prone to laceration by trauma than healthy spleen. Very extensive lacerations may be followed by death before surgery can be employed.

Trendelenburg¹ states that vomiting is the most important guide to diagnosis of ruptured spleen, that simple contusion of the alimentary tract is rarely accompanied by vomiting. He further states that ruptured spleen is usually not diagnosed prior to laparotomy.

Watkins² states that the mortality following removal of a healthy spleen for rupture is 40 per cent., with the non-operative mortality probably 100 per cent.

Nystrom⁵ reports three cases in which intestinal paresis was a prominent symptom.

Ross in the *ANNALS OF SURGERY* for July, 1908, summarizes splenic ruptures found in the literature as follows: Of 220 cases unoperated, 17 recovered, giving a mortality of 92.3 per cent. of 67 cases operated, 38 recovered and 29 died, giving a mortality of 43.3 per cent. In two cases the splenic laceration was repaired, one died and one recovered. In the splenectomies 13 of the patients had complicating injuries, from which nine died.

Sajous states that splenic laceration or punctures of the spleen if unoperated are usually followed by abscesses, which are very difficult to heal. In the Civil War 93 per cent. of gunshot wounds of the spleen were fatal, while in the World War in eight cases reported by Duval mortality was as low as 37.5 per cent. In *Progressive Medicine*, June, 1920, four cases reported by Willis³ are quoted. One case complicated by cerebral concussion could not be operated upon, three of the patients complained of agonizing pain in the left shoulder, which was promptly relieved by splenectomy.

That several days may elapse before a ruptured spleen becomes manifest, due to the subcapsular hæmatoma, is conceded by all surgeons who have had these cases to treat.

One case of a spontaneous rupture of the spleen is reported by Shorten,⁴ in *British Medical Journal*, in which a soldier of the British army was seized by severe pain while walking about, sudden vomiting with rigidity, free fluid in the abdomen, no localized symptoms. Splenectomy was followed by recovery. Gangeli reports a case of apparent recovery from a ruptured spleen, who after nineteen days left the hospital and returned later with a sudden severe pain and died with an abdomen full of blood. Connors reports in the

ANNALS OF SURGERY for July, 1921, a case of spontaneous rupture of the spleen, which at operation showed a large subcapsular hæmatoma, which ruptured on manipulation, showing deep rents in the parenchyma.

Nolan and Watson⁶ report on 30,000 malarial cases admitted to Colon Hospital in eight years; there were only three cases of spontaneous rupture of spleen.

Connor and Downes⁷ reported a spontaneous rupture of a typhoid spleen and were able to collect only twelve other cases.

Fauntleroy⁸ reports a case who experienced severe pain, left shoulder, and attaches great importance to this symptom, which was relieved by operation. This same symptom was reported as present in the case of Connor and Downes.

In each of our cases we have made careful blood studies, which show a considerable increase of the total leucocyte count following splenectomy, which persists with more or less irregularity for a period of one to two months. Case I was extensively studied with reference to the blood and leucocytes following splenectomy and reported by Major Milton W. Hall, in the *American Journal of Medical Sciences*, July, 1920. From the study of the three cases above reported and those reported by others, especially the four cases reported by Willis, the one by Fauntleroy and one by Connor and Downes the following conclusions are drawn:

1. That the healthy spleen may rupture spontaneously or by comparatively slight trauma.
2. That the symptoms at first may be slight, some dizziness, nausea or vomiting with restlessness and indefinite abdominal pains or we may have immediate symptoms of severe intra-abdominal hemorrhage depending on whether the capsule of the spleen has ruptured or remains intact, forming a large subcapsular hæmatoma.
3. That with our three cases, three of Willis', one of Fauntleroy's and one of Connor and Downes, an agonizing pain was experienced in the left shoulder, and we believe that if evidence of this radiating pain from the splenic region to the left shoulder can be elicited in any indefinite abdominal case with evidence of hemorrhage, that one may safely conclude that he has a ruptured or lacerated spleen to deal with.
4. That in view of the high mortality of unoperated cases, we believe that the only safe treatment is immediate splenectomy.

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CYSTIC DILATATION OF THE COMMON BILE DUCT

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THE literature records but thirty-six cases of cyst of the common bile duct. The condition must indeed be rare since McConnell (Dublin) in a review of the literature covering the past one hundred years states: "It is of interest, however, to note that the first case resembling the one described was a patient in Whitworth Hospital in 1817." The marked progress of abdominal surgery during the past few decades does not seem to have increased the frequency of cystic changes found in the biliary passages. The term cyst in its true sense, when applied to the common bile duct, is descriptive but does not adequately convey the nature of the anatomic pathology found present. In all probability the condition is not a cyst but a diverticulum of the duct and should be so designated.

In reviewing the cases reported we were impressed with the fact that some of these may also have involved biliary passages other than the common bile duct. This factor may be applied to the case under discussion, but inasmuch as we cannot definitely prove or rule out either, it might be well to include this case under the classification of the cyst or diverticulum of the common bile duct.

In consideration of the rare occurrence of this condition it would seem advisable to report each case encountered, with the hope that repeated investigation will cast more light upon its pathogenesis.

Mrs. E. E., white, aged fifty-six years, nativity American, and occupation a domestic, was admitted to the service of Doctor Rind of the City Hospital, Springfield, Ohio, April, 1920. Her chief complaint consisted in an enlargement of the upper abdomen, associated with a dull aching pain which radiated to the back. Her family history was negative. The patient stated that she first noticed a slight swelling in the epigastrium at the age of twenty years which increased steadily but very slowly in size for twenty-eight years or until 1912. There had been no pain up to this time, when upon undue exertion she felt a "giving way" sensation in the region of the swelling, and states, that since that time, the tumor has increased rapidly in size, and has been accompanied by pain. She has had marked intermittent jaundice during the past four years. The patient has a poor appetite and states that practically all food "sours" in the stomach, producing a large amount of gas.

Physical examination revealed a middle-aged female first seen lying in bed and apparently suffering no acute distress. Her complexion was "muddy" or turbid. Nothing of note was found in the head, neck, or chest. The abdomen was greatly distended. This enlargement was more prominent than is usual in a full-term pregnancy. The disten-

tion could be palpated as a non-movable tense mass. Manipulation did not produce pain. The mass was distinctly dull upon percussion and transmitted a "muffled" wave of fluctuation. In general outline the enlargement seemed to occupy the entire upper abdomen with considerable extension below the umbilicus.

X-ray examination revealed a large shadow extending upwards, pushing the diaphragm and liver as high as the eighth interspace. The urine showed an abundance of albumin with a few hyaline and granular casts and a trace of bile.

Operation revealed an enormous cyst, practically extending as far as the examining hand could reach. The cyst wall was found to be adherent to every adjacent organ including the stomach, pancreas, liver, intestine, and portions of the parietal peritoneum. During the necessary manipulation in an attempt to discover the origin of the cyst the wall was accidentally ruptured, allowing a sudden gush of approximately eight litres of a thin greenish-yellow fluid. The sudden release of intra-abdominal pressure caused quite a marked reaction in the patient's condition and necessitated a rapid examination of the abdomen which revealed dense adhesions between the cyst, the aorta and vena cava. This prohibited a possible chance of complete dissection at this time. While the other abdominal viscera were displaced they were apparently normal in so far as could be determined by a rather hurried examination. A considerable portion of the anterior wall of the cyst was removed. A large rubber drainage tube was sutured in the remainder and the abdomen was closed.

The immediate post-operative convalescence was uneventful. The patient continued to drain a large amount of the cystic fluid for three weeks when the wound healed. Shortly after this she developed a small abscess to the right of the incision, which was drained with immediate relief of the local reaction. This opening persisted through January, 1921, draining a small amount of clear straw-colored fluid. The patient was at that time other than for the presence of the draining wound enjoying excellent health, having been freed entirely from her symptoms prior to operation.

Gross examination of the portion of the cyst wall excised reveals a thin sheet-like mass of tissue varying from 0.25 cm. to 1 cm. in thickness, averaging approximately 0.5 cm. One surface is covered with peritoneum scattered over which is found evidence of old adhesions. The opposite or inner surface is wrinkled, soft and dull in appearance, presenting numerous areas which are brownish in color. These areas appear and feel velvety. In its general consistency this portion of the cyst wall seems fibrous and strong.

Microscopically the inner surface is composed of a single layer of well-defined columnar epithelium resting upon a rather substantial sub-mucous coat of connective tissue. Within this fibrous wall are found occasional cross-sections of small openings lined with a single layer of columnar cells resembling very closely the structure of the smaller bile ducts found within the liver. Here also are encountered occasional areas of liver substance, and what appear to be perfectly normal liver lobules can be demonstrated.

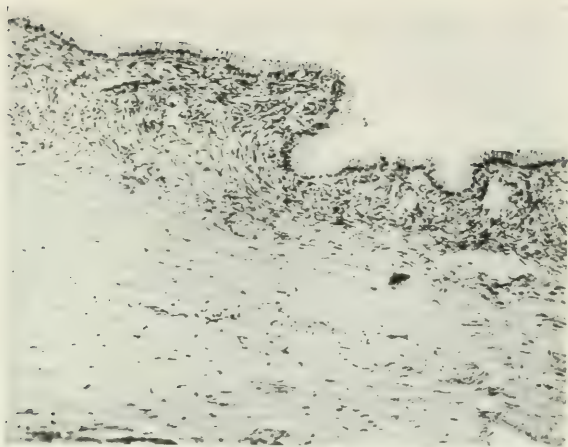


FIG. 1.—Low power photomicrograph showing lining membrane of cyst wall composed of columnar epithelium.

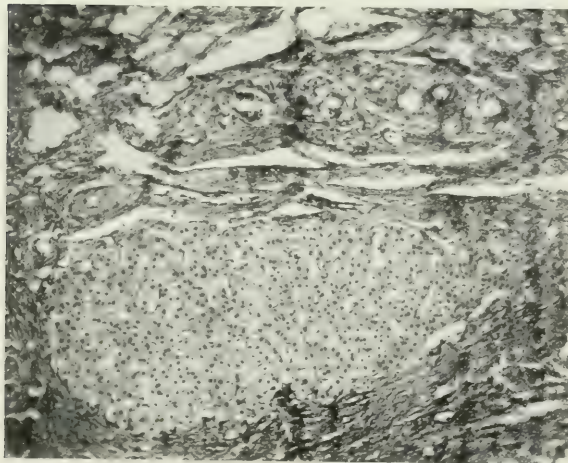


FIG. 2.—Low power photomicrograph showing portion of liver tissue within wall of cyst.

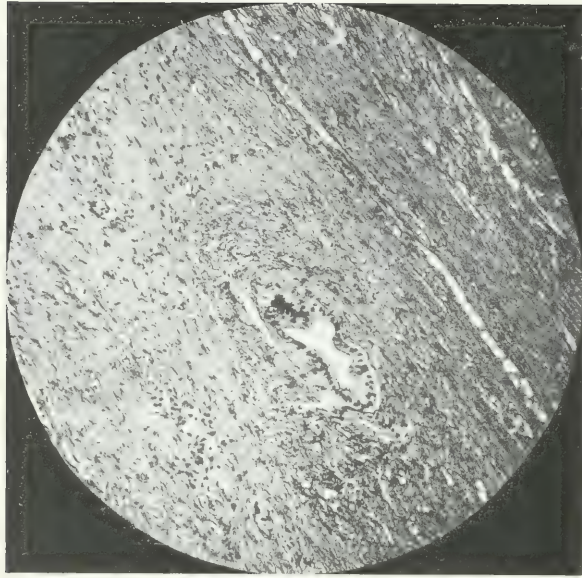


FIG. 3.—Low power photomicrograph showing cross section of what appears to be a slightly dilated biliary duct.

It would seem that the cyst either had its origin within the liver or the enlargement having been primarily periglandular had encroached upon the liver substance and thinning it out by pressure until this excised portion at least contained some much thinned out liver tissue.

Waller, in a recent discussion of this condition, mentions as a possible etiological factor, the presence of a valve-like fold in the mucous membrane associated with a kink in the lower end of the duct. This remains closed until sufficient intra-cystic pressure is accumulated by the secreted bile to force the fold to one side or obliterate it. This temporarily releases the pressure contained within the walls of the cyst to the point when the valve-like arrangement can reform. He states that "the above-described valve formation gives sufficient explanation of the question, why the fully formed cyst cannot empty itself, and why it undergoes an ever increasing enlargement of volume. But it is impossible to suppose that the valve can be developed until a part of the duct has widened into a sac-like cavity and the existence of the valve is therefore not sufficient to explain what causes the first enlargement."

Congenital malformation of the duct would seem to be a plausible explanation. Heiliger in 1910 found a decided distention in an almost mature foetus at autopsy. With the exception of our case, the condition has always been found in childhood or young adult life. Of the thirty-six cases reported the youngest was two years and the oldest twenty-five years of age. Our patient, although fifty-six years of age, first noticed the swelling of the epigastrium thirty-six years before, or at the age of twenty. In analyzing the reported cases it is evident that should the condition exist from the time of birth it does not necessarily follow that it should show immediate symptoms. "On the contrary, all observations seem to indicate that it is in the beginning absolutely latent to its owner." This period of latency varied with different individuals, and coupled with the fact that the cyst is apparently ever increasing in size, it would seem that the first symptoms would in the main depend upon not only its anatomical arrangement, but the size of the foetal diverticulum. If at the time of birth the sac is well developed, the symptoms may arise in the very young, otherwise it would seem the patient may be free from any disturbance until sufficient dilatation of the cyst is reached to seriously interfere with biliary function and drainage.

The not infrequent dilatations of the common duct occurring secondary to purely mechanical diseases of the gall-passages or pancreas, as a rule convert the duct into a cylindrical tube, retaining its original shape, and even when of long standing seldom if ever exceeding the diameter of the small intestine. The conditions presenting in the subject under discussion differ markedly in that the enlargement involves only the upper and middle thirds of the duct. In most instances the cases reported record enlargements of about the size of a child's or man's head. In our case the cyst was much larger, containing approximately 7 or 8 litres of fluid.

With regard to the treatment, an investigation of the reported cases would

seem to indicate that simple drainage of the cyst is inadequate. Twenty-one out of thirty-two cases treated by drainage with the production of an external fistula died following operation, the time elapsing between operation and death in most instances being but a few days. Three of these cases lived from one to three months after operation. The cause of death in these cases was the development of an acute purpuric condition or a sudden fatal hemorrhage. One case recurred three years after operation with the formation of a fistula; the patient, however, dying of tuberculosis. McConnell reports in his table a case having been drained on two separate occasions with the patient living three years and eight months after the last operation, the fistula closing two years and eight months after the second drainage.* The conditions met at the time of operation of our case necessitated the institution of drainage in order to shorten the operation because of the sudden collapse of the patient while on the table. Here instead of suturing the cyst wall to the abdomen as had been practiced in the above cases, a large rubber tube was inserted within the cavity and brought out through the incision. The uneventful convalescence in this case was an agreeable surprise.

In the remaining eleven cases treated surgically, three of these in which drainage was followed by an attempt at choldochenterostomy resulted fatally. Three of these in which drainage was followed by successful choldochenterostomy recovered. Extirpation of the cyst was performed in three cases, all of which died. Two cases in which primary operation consisted of choldochenterostomy have lived.

1st Op.	2nd Op.	No. of cases	died	Recurrences and Remarks
Drainage		19	18	One recurred 3 yrs. with fistula and died with tbc. One case with fistula at end of 9 months.
Drainage and Choldochenterostomy		1	1	
Drainage	Drainage	1	0	Living 3 years 8 months, fistula closed 2 yrs. 8 months.
Drainage	Attempt at Choldochenterostomy	3	3	0
Drainage	Attempt at Choldochenterostomy	3	0	3
Extirpation		3	3	0
Choldochenterostomy		2	0	2
Unoperated		4		
Fœtus		1		
Totals		37	25	7

* McConnell (British Journal of Surgery, April, 1920, p. 523). Our case has been added to the list of patients having had drainage in first operation, making the total number of cases recorded to date 37.

SUMMARY

By the way of summary it is of interest to note that during the past century with its phenomenal development of abdominal surgery there has been no apparent increase in the percentage of the occurrence of this condition. The preoperative diagnosis has never been recorded due no doubt to its rare incidence. The striking clinical feature present in practically each case reported has been intermittent jaundice in the child or young adult usually associated with some form of palpable tumor mass in the upper right quadrant of the abdomen. It would seem that cystic dilatation of the bile passages should be considered in the differential diagnosis when the above-mentioned clinical symptoms are encountered.

The case serving as a basis for this discussion is a female, aged fifty-six. Her symptoms, however, were noticed at the age of twenty. Since this time her main discomfort having been gastric disturbance, intermittent jaundice, pain, and tumor formation. So far as we have been able to determine, this is the oldest patient reported in the literature with this condition. The cyst containing approximately 8 litres is in all probability the largest on record. The patient at the present time (September 1, 1921) is enjoying good health and is able to attend to her household duties, the wound having healed.

We wish to express our appreciation to Doctor Rind for the privilege of studying this most interesting case.

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SOME PROBLEMS IN CONNECTION WITH THE SURGERY OF THE BILIARY TRACT*

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THE advances that have been made in the surgical treatment of diseases of the biliary tract are a source of satisfaction to all of us, but those most skilled in gall-bladder surgery are readiest to admit that the limit of attainment is still far from having been reached. Rational treatment presupposes accurate diagnosis. Unfortunately, the recognition of gall-bladder disease is often accompanied by difficulties, though we have at our disposal every refinement of diagnostic aid. A complete history, a careful physical examination; a thorough röntgenological study are of great value, but they do not always enable us to ascertain the exact condition existing in the biliary passages. The use of the duodenal tube and magnesium sulphate, according to the technic developed by Lyon,⁶ is probably a valuable procedure, but it cannot tell us whether we have calculi or not; in other words, through its use we are not always able to determine whether the case is one likely to be benefited by further medical treatment or whether immediate surgical intervention is desirable. Even after opening the abdomen and exposing the gall-bladder, I am sometimes unable to state whether it is the seat of a pathological process or not; and it has been a source of chagrin to me that on several occasions I have failed to detect the pathology of certain gall-bladders removed by other surgeons. The presence of calculi, thickening and contraction of the gall-bladder walls, the enlargement of the lymphatic glands, these are all fairly obvious indications of disease of the gall-bladder; but, unfortunately, they are sometimes absent in patients with a history suggestive of gall-bladder infection. C. H. Mayo⁷ has emphasized the desirability of early diagnosis of cholecystitis, in order that suitable surgical measures may be instituted and the patient saved from the danger of serious complicating disease. While this is a most laudable object, its pursuit may result in subjecting a considerable number of patients to needless surgical mutilation.

The rank and file of surgeons are influenced by the attitude of the leaders in the profession, and we have seen instances of too enthusiastic adoption of the suggestion of these leaders by men who are lacking in the judgment and skill that the former possess. All of us have probably encountered instances where the optimistic surgeon has removed the appendix for the relief of obscure abdominal discomfort, but where neither the subsequent history of the patient nor the report of the pathologist served to justify this course. Over forty years ago Dr. Alexander Goodell⁴ protested against needless pelvic operations on female patients, and it has seemed to me that we would do well

* Read before the Philadelphia Academy of Surgery, October 3, 1921.

to remember the following words from his pen: "As the Angels, according to the Schoolmen of the middle ages, fly from point to point without traversing the intervening distance, so, with like swiftness, the physician of the present day jumps from any distinctively female ache to an ovarian conclusion." Far be it from me to attempt to belittle the importance of early operation in cases of gall-bladder infection; the unfortunate results of delay are too well recognized for any intelligent surgeon to advise it, but, at the risk of incurring the suspicion of envying a colleague's diagnostic skill, I cannot forbear feeling a little skepticism when there are reported by some operators such a large preponderance of the cases of simple cholecystitis as compared to those accompanied by calculi. Is there not a possibility that the surgeon of the present day is becoming a little prone to draw a gall-bladder conclusion from any upper abdominal discomfort? With me this is a distinct problem; we find ourselves between the two horns of a dilemma; on the one hand, we wish our patient to derive the benefit of early operation; but, on the other hand, we encounter the difficulty of making a positive diagnosis in these early cases.

Having demonstrated the existence of a pathological process in the gall-bladder, the next problem we encounter is in regard to the manner of treatment. Disregarding medical methods, it is felt in the great majority of clinics that the decision must be made between retention of the gall-bladder with drainage or a removal of that organ. To acknowledge changing views as to the relative value of these two operative measures may be done with impunity; such a course has been rendered fashionable by most of the shining lights of the profession. I had satisfied myself that cholecystectomy was the operation of choice, to be performed in all cases of cholecystitis unless there existed a definite contra-indication, but of recent years, I have come to feel that the decision is not always so simple as we could wish.

In the first place, it has been clearly demonstrated that the gall-bladder normally performs two definite functions, namely, the concentration and the storage of the bile, both of which may play a rôle of importance in the digestive processes. Though it has been shown by Judd⁵ and others that patients may enjoy apparent good health for years after a cholecystectomy, nevertheless we should hesitate to remove an organ that normally exercises very definite functions. Of course there are conditions which clearly indicate removal of the gall-bladder; the presence of a malignant growth, hydrops of the gall-bladder, cicatricial closure of the cystic duct, and the so-called strawberry gall-bladder; in such cases the only rational procedure is cholecystectomy, provided the condition of the patient justify undertaking the operation.

In the practice of every surgeon who does much gall-bladder work, there will be encountered certain patients, in whom the diseased condition has persisted for a considerable period of time. Many of these patients are at an advanced age; they may be overweight; and there is evidence of marked myocardial and renal involvement; they may be weakened by repeated exacerbations of the infectious process in the gall-bladder and ducts; jaundice of

long duration is not infrequently encountered. Not only is the patient's general state poor, but the local condition around the gall-bladder is such as to cause much anxiety. Dense adhesions bind the various structures together, interfering with proper function and distorting the anatomical picture so as to prevent a satisfactory palpation of the ducts. The gall-bladder may show thickened, contracted walls, or it may be distended with pus.

What course are we to follow in such cases as these? Does it not seem wisest to remove the gall-bladder which is probably the chief seat of the infection responsible for all the damage? From inspection, one can scarcely hope to see it ever again perform its normal function. It has been my experience, however, that in many of these cases cholecystectomy will prove disappointing and the results of cholecystostomy are surprisingly good. One reason for this is to be found in the general condition of the patient, this being so poor that many of them are unable to survive the relatively severe operation of cholecystectomy, while the milder cholecystostomy, a less trying tax on their strength, does not lead to a fatal outcome or the injury of important structures. It must be admitted that the necessity for secondary operations arises less often after cholecystectomy than after cholecystostomy; in other words, the morbidity after the former operation is less, from a quantitative standpoint, than is the case after the latter. But is this morbidity after cholecystectomy less severe when it does occur? My experience has led me to the contrary conclusion. While I have not been so unfortunate as to cut a common duct during the course of a cholecystectomy, it would seem that this is not the universal experience, judging by the number of papers dealing with methods of repair that have recently appeared in the literature. Then, too, secondary operations are occasionally necessary after cholecystectomy. Even the skilled operator may overlook common duct stones, and they may form in the ducts after removal of the gall-bladder. Everyone who has had to go in again and endeavor to locate an obstructing calculus after removal of the gall-bladder will agree with me that it is immeasurably more difficult and dangerous than is the case when the gall-bladder is present to serve as a guide and landmark. Finally, it is surprising to what an extent these apparently hopelessly crippled gall-bladders will recover after drainage, so that even those apparently most severely involved will eventually regain at least a part of their functional capacity. It is true that later a cholecystectomy may be found necessary, but it is usually the case that the performance of the preliminary cholecystostomy with the consequent relief of the pressing symptoms renders the patient a far better surgical risk than he was when first encountered.

I am sure that my attitude in advocating cholecystostomy and drainage in these severe cases of gall-bladder involvement will subject me to criticism; I am equally certain that my views in regard to the method of treatment of another type of case will call down condemnation on my head. What measures are we to adopt in dealing with a patient in whose gall-bladder there are apparently sterile calculi? What course shall we follow when we encounter

a case of low-grade cholecystitis, where we can demonstrate no bacteria or where the few found are of a very low degree of virulence? Often the discomfort experienced by patients with these conditions is slight; minor digestive disturbances, the eructation of gas, usually no attacks of severe colic; and it is possible that such conditions and symptoms may persist until the patient succumb at a ripe old age from some other cause than the gall-bladder disease. I believe that there are some surgeons, at least, who would advocate the drainage of such gall-bladders as I have described; feeling that it is unjustifiable to sacrifice an organ whose functional ability has been so little impaired. My experience has been, however, that in such cases as these, cholecystostomy with drainage, instead of yielding the desired relief, often renders the patient much more miserable than he was before falling into the hands of the surgeon. Impressed by such observations, we have sought the explanation, and we believe it is to be found in the results of certain animal experiments¹² that we have performed. We have, on numerous occasions, been able to show that sterile bile allowed to escape into the peritoneal cavity does not exert the lethal action that some authors would have us believe; moreover, it does not seem to call forth the production of dense adhesions. If, however, a foreign body be introduced into the cavity along with the bile, the character of the resulting adhesions is altered; they become much more numerous and dense. If, finally, infected bile plus a foreign body be introduced, there result adhesions of a density seen after no other intra-abdominal procedure with which I am familiar. How may these experimental observations be used to explain our clinical disappointments? In the praiseworthy attempt to drain away the infecting organisms and the remnants of calculi, we introduce a drain, our foreign body. It is indeed a moot point as to whether drainage is always effective in removing infectious material from the abdominal cavity; there is no question but that we introduce infectious material into this cavity when we allow a drain, extending from the exterior, to remain in it for any length of time. Fortunately, owing to the defensive powers of the peritoneum, this infection is not disseminated, but becomes localized, the adhesions serving to confine it to the region of the gall-bladder. These adhesions, though probably responsible for saving the patient's life, later often render this life scarcely worth the living. As Deaver³ so aptly expresses it in speaking of adhesions: "In many cases the symptoms and gravity of gall-bladder lesions are due, not to the gall-bladder affection *per se*, but to the accompanying adhesions." Again, in a later paper,² he states: "I believe that pericholecystic adhesions, the result of gall-bladder and duct infection, often give a clinical picture which is identical with that found in gall-stone disease, and do so in the entire absence of gall-stones at any time; and, after operation, they are capable of causing symptoms which mimic gall-stone colic."

Such considerations as these have led me to take what appears to be an extremely radical position. If these mildly affected gall-bladders are to be treated either by cholecystostomy with drainage or by cholecystectomy, I

unhesitatingly commit myself as favoring the latter, because I am convinced that a great majority of patients suffering from such a mild degree of gall-bladder involvement are rendered worse by the improperly termed "milder" operation of cholecystostomy with drainage. The attitude that the surgical profession as a whole has taken forced me into this position; there is no half-way ground; as treated in most progressive clinics, these patients are subjected either to a cholecystectomy or to a cholecystostomy with drainage.

In 1912 I became impressed with the fact that practically none of our patients gave any evidence of leakage of bile after the performance of the classical cholecystectomy with the insertion of drainage. If leakage did not occur, why would it not be safe to dispense with the drainage? At the time, I was unaware that such omission had been practiced years before; some of the foreign surgeons having obtained results, even with a comparatively crude technic, which seem amply to justify a more extended trial of this method of procedure.

After five years' experience with cholecystectomy without drainage performed in the most favorable type of cases, I reported¹⁰ the results that I had obtained in a series of thirty-eight cases, where drainage was omitted after removal of the gall-bladder. Of this number one patient succumbed, but neither in this fatal case nor in any of the others was there any indication of leakage of bile. Since the appearance of my paper, Richter⁹ has adopted my suggestion; and, still more recently, Bottomley¹ has expressed his approval of the omission of drainage in certain cases of cholecystectomy and has stated that he has obtained excellent results by such omission. Last year I was able to report¹¹ the results that I had obtained by a more extended trial of this method, and showed that of a series of seventy-two patients, death occurred in only two instances. Both of the fatal cases came to autopsy and in neither was there the slightest evidence of bile leakage. These results seemed amply to justify the conclusion that: "the omission of drainage after the majority of operations of cholecystectomy is a procedure that is perfectly safe; and the results obtained by such omission are distinctly superior to those following the older method of packing or draining with gauze." It must be understood, therefore, that in advocating cholecystectomy in preference to cholecystostomy with drainage in the treatment of these mild cases of gall-bladder disease, I am referring to cholecystectomy without drainage; for, if drainage be used after cholecystectomy, we produce many of the same crippling adhesions that follow cholecystostomy with drainage.

But are we forced to choose between the removal of an organ that normally performs a definite function and a retention of that organ only at the expense of producing adhesions which impair its function and may render the condition of the patient more unsatisfactory than it was before operation?

In 1883 Meredith performed the so-called "ideal" cholecystotomy. In this operation the gall-bladder is opened, the calculi removed, the incision in the gall-bladder sutured, and the abdomen closed. The operation has re-

ceived the condemnation of succeeding generations of surgeons, and the following emphatic statement of Moynihan⁸ in regard to it illustrates the attitude of most modern operators: "Ideal cholecystotomy is anything but ideal in practice, and is an operation that is mentioned now only that it may be unequivocally condemned."

Faith is at times indeed a virtue. Blind faith, the passive acceptance of the views of the recognized leaders may, however, retard our progress, and it has seemed to me that in the sweeping condemnation of the "ideal" cholecystotomy, we have been guilty of such an error as this. It is easy to understand how in the earlier days of biliary surgery, with a poorly developed technic and less diagnostic skill, the performance of cholecystotomy without drainage on unsuitable cases led to disaster. But is not the condition different now? Is it not a well-known fact that many patients come to the surgeon with only moderate lesions in the gall-bladder? In such cases as I have already described, where there are no viable organisms, where the calculi are practically only sterile foreign bodies and where we can detect no pathological changes in the gall-bladder, why should it not be practicable to open the gall-bladder, remove the calculi, and close without drainage? Is such a course much more radical than the omission of drainage after the repair of a perforating duodenal ulcer, or after removal of a renal calculus? Finally, why should the omission of drainage after cholecystotomy on these selected cases be accompanied by any more danger than such omission after cholecystectomy? At the time of my first paper the omission of drainage after cholecystectomy was a procedure looked on askance; now it is coming to be widely practiced. Moreover, Richter⁹ has revived the old practice of omitting drainage after choledochotomy, with apparently excellent results. If, therefore, the "ideal" operation be practicable, there is offered us a middle course to be followed in certain selected cases; cases where there is a low-grade infection or no infection at all, where the gall-bladder shows no demonstrable evidence of pathological changes, and, presumably, has suffered no alteration of its functional ability. Would it not be immeasurably better if we could preserve such a gall-bladder after removing the calculi which might later, if allowed to remain, give rise to obstruction or, acting as irritants lead to a fresh invasion of the gall-bladder by pathogenic organisms?[†]

The work of Lyon in effecting non-surgical drainage of the biliary passages seems to be full of promise as an adjunct to this "ideal" operation. After the removal of the calculi the patient may be subjected to a course of treatment as outlined by Lyon, and, by this means, it would seem that any infection that might be left in the gall-bladder could be removed through the duodenum. By following out such a plan as this, we can probably preserve a functionally unimpaired organ without subjecting the patient to

[†] I am familiar with the work of Rosenow and others, in which pathogenic organisms were demonstrated in the wall of the gall-bladder, but it would seem to me unusual, to say the least, for these organisms to remain in the wall of the organ without appearing free in the bile.

the danger, nay, probability of adhesion formation with resulting discomfort and disability greater than that which existed before operative measures were undertaken, and by so doing, it would seem that we are taking a definite step forward in the development of biliary surgery. I am practicing cholecystotomy in selected cases and believe it has a distinct field of usefulness in surgery of the gall-bladder.

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THE RESULTS OF HIGH LIGATION OF THE CYSTIC DUCT IN CHOLECYSTECTOMY*

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IN this paper we shall not discuss the indications of the operation, but we shall endeavor to show what happens after the operation has been performed. The results of this operation are much more important from the standpoint of the physiology of the biliary system than from the standpoint of anatomy, hence we shall pass over the latter. The experimental work reported in this paper was done in the Laboratory of Surgical Research of the University in 1916 and 1917; the War prevented the publication of the results. In spite of the delay and the fact that similar work has been done elsewhere since the work upon which this paper is based was carried out, we have thought the subject of sufficient importance to warrant this presentation.

First of all let us consider what is the normal physiology of the gall-bladder. That the gall-bladder is an organ essential to life or health, or that it has a specific function has not as yet been proved. Hohlweg¹ considers that while the gall-bladder is an important organ, it is not a vital one.

Woods Hutchinson² after post-mortem studies thought the gall-bladder was practically a functionless organ and probably vestigial. The chief objection to regarding the gall-bladder as vestigial resides in his mind that we have no certain evidence of its ever having had a function whose value was in any way compensatory for the dangers to which it exposed its possessor. It has this much title to recognition as of some vital importance in that it appears at an early period in the development of the liver. From the beginning it displays irregularities as to shape and size, and also that it is found in some animals and not in others. With this record of inconstancy, it can hardly be asserted that the gall-bladder exercises any very vital or important function. He is of the opinion that the gall-bladder is nearly a functionless organ.

The physiologists as well as surgeons, such as Deaver and Ashhurst³ and others, are of the opinion that the gall-bladder has a function, and when we admit it has a function we are compelled to admit, that that function, whatever it may be, should be conserved. That the gall-bladder has a function of storing bile there can be no doubt. Starling⁴ claims the exigencies of the body require a continuous excretion of bile by the liver, but a discontinuous entry of this fluid into the small intestine. This discontinuity into the intestines is secured in the majority of animals by the existence

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of the gall-bladder, a diverticulum from the bile ducts, in which all bile secreted during the intervals between the periods of digestive activity is stored up. Magie⁶ has never seen an empty or collapsed gall-bladder when examining it during the course of operations in the upper abdomen. The fact that it is always filled with bile goes to prove that it has much to do with keeping up and regulating the pressure in the bile ducts and liver. Lapenta⁹ is of the same opinion. Judd⁷ and Gillette⁸ compare the gall-bladder to a tension bulb acting as a regulator of the flow of bile. Of course the sphincter of Oddi is also concerned in the pressure of bile in the biliary system, as well as the rate of bile secretion. The escape of bile into duodenum is at least partially under the control of the sphincter of Oddi, thus the fluctuation of intra duct pressure is in all probability compensated by the gall-bladder. Kemp,⁹ Leede,¹⁰ Lamson¹¹ and others regard the gall-bladder as a secretory organ which elaborates and adds something that is of importance either to the general body economy or to the mechanism of bile expulsion or chemical action.

Going on the hypothesis that the gall-bladder has some definite function, the question arose, "what would be the effect on the biliary system after cholecystectomy with a high ligation of the cystic duct?" This suggestion was presented to us by Dr. Joshua E. Sweet, the Director of the Laboratory, after he had observed a slight enlargement just proximal to a ligature placed about the cystic duct. This observation was made post mortem about three weeks after the ligature had been put around the cystic duct.

We used a series of dogs on which we performed cholecystectomy employing the following technic; the dog was anæsthetized with ether and the abdomen opened by a right rectus incision. On exposing the gall-bladder the fundus was caught with a hæmostat and drawn upward, thus putting the cystic, hepatic and common ducts on tension. The length and diameter of the cystic duct was then measured. With an aneurism needle a ligature was passed about the cystic duct and artery below the neck of the gall-bladder. The ligature was tied and the neck of the gall-bladder was grasped with a curved hæmostat and divided between the hæmostat and ligature. The gall-bladder was then carefully dissected out from below upwards and removed. No attempt was made to close or drain the gall-bladder fossa. The wound was closed in the usual manner without drainage. The length of the cystic duct stump varied from 6 mm. to 2 cm. in length, and the diameter was approximately 2 mm.

Of the ten dogs operated, one died during the operation, and the others recovered. Those that recovered were chloroformed and autopsied at intervals varying from six weeks to fourteen weeks after operation. In a dog, six weeks after operation, in which a duct 6 mm. in length was left, we found a small bud-like dilation at the end of the cystic duct stump. This dilation was filled with bile. The common and hepatic ducts were somewhat dilated.

In seven of the other eight dogs, we found dilation of the cystic duct stump quite marked. In some the cystic duct stumps had increased in length from

1.2 cm. to 2.5 cm. and were 1 cm. in diameter. They were all filled with bile.

On histological examination of a section from these newly formed bladders all the coats of the gall-bladder could be recognized. The histology of the cystic duct resembles so strongly that of the gall-bladder that we cannot definitely state whether there was simply dilation of the duct or a true reformation of the gall-bladder. If it is simply a dilation of the duct there is certainly some hypertrophy, for the walls of the newly-formed sac are thicker than a pure dilation would permit and, moreover the layers do not show the thinning and stretching such as a pure dilation due to mechanical means would permit without true hypertrophy.

One dog in which the cystic duct was cut off practically flush with the common duct showed no dilation of the small stump, but exhibited a marked dilation of the common and hepatic ducts. In two of the eight cases with dilation, the bile had become inspissated and apparently was beginning to form calculi. A microscopic study of these dilations was that of a chronic catarrhal cholecystitis. It seems the dilation had not the power to force the bile out.

Looking over the literature, we find that dilation of the cystic duct following removal of the gall-bladder in dogs was first done by Zambeccari. It was later corroborated by Oddi¹² in 1889, DeVoogt¹³ in 1898, Von Haberer and Clairmont¹⁴ in 1904, Andrews,¹⁵ Eisendrath and Dunlavy,¹⁶ and others. Lapenta⁶ removed the gall-bladders from ten dogs. Twenty to sixty days following the operation, the abdomen was opened to examine the condition of the common duct. In every case the duct was dilated and in two dogs the stump of the cystic had dilated in bulb fashion, showing the attempt of nature to restore the function of the gall-bladder, whatever that may be.

That the stump of the cystic duct dilates in a certain number of cases there is no doubt. Kadian¹⁷ reports a case of gall-stones with cholecystectomy, and six years later there was a return of symptoms. The second operation showed the cystic duct was dilated and contained several cholesterol stones. He found twenty-eight cases in the literature similar to his own. Von Haberer¹⁴ reported a case in which gall-stone formation had taken place. Kehr¹⁸ reports having removed a cystic duct stump that had attained a length of ten centimetres. Floercken¹⁹ found a dilation of the cystic duct the size of a plum three years after cholecystectomy, and a brown calculus embedded in the wall of the dilation and none elsewhere. Eisendrath²⁰ reports the following case: Patient had a cholecystectomy performed by another surgeon in 1910 at which time a small, hard gall-bladder containing two large calculi were found. Fragments of calculi and sandy detritus were also found in the cystic duct. Two years later there was a return of pain accompanied by icterus. At a second operation by Eisendrath at this time, the cystic duct was found to be dilated, forming a pseudo gall-bladder two and one-half centimetres long, containing a calculus the size of a millet seed.

In addition we wish to report the following cases:

CASE I.—Through the courtesy of the late Professor Francis E. Stewart, of the Jefferson Medical College, we cite the following: The patient was operated on by Doctor Stewart on November 29, 1915, at which time a cholecystectomy was performed. No stones were found at operation, but the histological examination of the gall-bladder was that of a chronic catarrhal cholecystitis. She recovered from the operation and was free of all symptoms until February, 1916, when she was taken with sudden attacks of upper abdominal pain severe in nature. This attack was attended by nausea and vomiting and required morphine for the relief of pain. The attack lasted for about two hours and was not followed by jaundice. The attacks occurred independent of the taking of food, some occurring while asleep at night and others while engaged in her household duties. The pain as a rule disappeared between attacks and never radiated away from the upper right abdominal quadrant. On admission to the hospital the physical examination was negative, except for marked tenderness over the gall-bladder region. No distinct mass was felt. Laparotomy was performed by Doctor Stewart September 28, 1916, which disclosed a mass of adhesions of the colon to the anterior abdominal wall, from the stomach to the edge of the liver, and a small hard mass at the right of the gall-bladder which had been removed at the previous operation. No stones were felt in the dome of the liver or in the common duct. The mass was incised and a quantity of bile and mucus escaped. A probe inserted into the opening could be passed upward into the liver and downward into the common duct. The opening was drained and the patient discharged much improved on October 22, 1916.

CASE II.—By permission of Dr. John B. Deaver, from his service at the University Hospital. M. E. S., age sixty. Appendectomy ten years ago, cholecystectomy four years ago, chronic colitis. Patient is laid up two or three days out of every week with pain in the abdomen and vomiting. The vomitus contains food ingested twelve to sixteen hours before. The pain is of a colicky nature. The attacks do not seem related to any particular kind or quantity of food. They usually come on after the patient has retired. Examination of the stomach contents showed a high acidity and retention. No blood. Examination of the stool was negative. A gastro-intestinal X-ray was advised but refused. A diagnosis of abdominal adhesions, causing pyloric obstruction, was made. Operation by Doctor Deaver disclosed many adhesions about the pylorus and upper bowel. At the site of ligation of the cystic duct there was an outpouching about four and a half centimetres in length. This was removed. On opening it, no stones were found, but it contained a large quantity of inspissated bile. This new growth was removed, ligating flush with the common duct. The transverse colon (after freeing many adhesions) was turned up and interposed between the stomach and liver. The abdomen was closed without drainage.

The patient had a somewhat stormy convalescence due to a pyelitis which developed, but eventually recovered.

Twenty-two months have elapsed since the operation, during which time the patient has been free from any abdominal discomfort.

CONCLUSIONS

1. Where a cystic duct stump is left, it usually dilates to form a pseudo gall-bladder; hence we may get a recurrence of the symptoms after a cholecystectomy.

2. Where the cystic duct is ligated flush with the common duct, there is general dilation of all ducts, indicating that there is pressure in the biliary system.

3. The gall-bladder is not essential to life, but it seems to have a very definite function of storing bile and acting as a tension bulb to regulate pressure in the biliary system.

4. Nature endeavors to restore the normal condition in the biliary system, after the removal of the gall-bladder by the ducts, including the cystic duct stump undergoing a dilation and enlarging. It is an indication that nature rebels against man's attempt to improve on her, hence the gall-bladder must have some definite function.

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DUODENECTOMY

(AN EXPERIMENTAL STUDY)

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A PRELIMINARY report has been made of the results of our experiments dealing with the removal of the duodenum.¹ We are now submitting a further report of these experiments. The important physiologic and anatomic position of the duodenum and the desirability of determining whether it has a specific function or whether its physiologic action is merged with the rest of the gastro-intestinal tract were discussed in the preliminary report. It should be emphasized that our research deals also with the possible function of Brunner's glands.

REVIEW OF PREVIOUS WORK

A large number of experiments have been performed on the duodenum. The most important of these, and in fact the only ones presenting definite data, were published after our investigation had been started. The first experiments on the removal of the duodenum were performed in an attempt to determine the relative part the duodenum and pancreas might have in the production of experimental diabetes. The most important of these researches are those of Benzi and Reale,² Pflüger,³ Ehrmann,⁴ Lauwens,⁵ Minkowski,⁶ Cimatori,⁷ Tiberti,⁸ Rosenberg,⁹ and Bickel.¹⁰

Benzi and Reale partially removed the duodenum in dogs, that is, they resected the portion not attached to the pancreas. By this method neither the common bile duct nor the pancreatic ducts were in any way molested and, on the other hand, none of Brunner's glands was removed.

Pflüger removed the duodenum and small intestine from frogs and dogs. In the latter species he performed the same operation that Benzi and Reale performed, that is, only a partial resection of the duodenum.

Ehrmann removed the duodenum from several dogs. The jejunum was anastomosed to the stomach. The pancreatic ducts were either ligated or implanted with the common bile duct into the stomach. The animals survived from a few days to a week, death evidently being due to or associated with trauma to the pancreas because widespread fat necrosis was always present.

Lauwens operated on several dogs. In five he made a gastro-enterostomy, transplanted the common bile duct with the minor pancreatic duct and a small amount of duodenal mucosa into the stomach, ligated the major pancreatic duct, and removed the duodenum. Four of

the dogs died the first day after operation, and one lived until the thirteenth day. The other two animals were operated on in a similar manner, except that the common bile and minor pancreatic ducts were transplanted to the skin. One of these animals died on the ninth day, and one was still alive on the thirteenth day.

Minkowski successfully removed the duodenum from two dogs. This seems to be the first successful duodenectomy. The continuity of the gastrointestinal canal was established by a gastroenterostomy. Bile flow was maintained by a cholecystenterostomy. The animals seem to have remained well, but since the investigator was interested in diabetes, the pancreas was removed in each animal and further data with regard to the duodenum were not given.

Cimoroni removed the duodenum from dogs in a one-stage operation. The pylorus, duodenum, and the first portion of the jejunum were removed. The jejunum was anastomosed to the stomach either by the regular posterior gastroenterostomy technic, or by a Murphy button. The pancreatic ducts were tied and the common bile duct transplanted to the skin. Most of the dogs died immediately after operation. Four of them lived eleven, seven, six, and six days, respectively.

Tiberti removed the duodenum from nine dogs. He varied the type of operation. In three dogs he removed the duodenum, made a gastroenterostomy and transplanted the bile duct to the skin; in two, enteroanastomosis was made; in two, enteroanastomosis and cholecystenterostomy, and in two, the operation was complicated by the removal of a portion of the pancreas. None of the animals lived very long after the operation, the longest period being five days.

Rosenberg removed the duodenum, although not completely, from five dogs. He performed gastroenterostomy and cholecystenterostomy, and ligated the pancreatic ducts. Four of the animals died shortly after the operation; one was still alive on the twenty-third day.

Bickel removed the duodenum from two dogs. He performed gastroenterostomy and transplanted the common bile duct and pancreatic duct to the skin. One of the animals lived ten days and the other four and a half weeks.

Gaultier¹¹ studied the effect of injury by caustics to the duodenal mucosa in animals, and Zak¹² reported two observations on the effect of caustics on the duodenum in man. Herlitzka¹³ observed the effect of the injection of vaselin and nicotine into the duodenum of frogs.

Maury,¹⁴ in an extensive research on high obstruction, concluded that the duodenal epithelium contained something of great importance to life, and particularly with regard to the toxic condition of obstruction. Matthews,¹⁵ on the basis of Maury's conclusions, performed several series of experiments in which the duodenum and jejunum were isolated and drained by various combinations of methods. From the results of these experiments he concludes that the removal of the duodenum is incompatible with life longer than seventy-two hours.

Stasoff¹⁶ studied the effect of removal of various portions of the gastrointestinal tract. None of the animals in which he removed the entire duodenum survived. He was able to keep one animal alive in

which the portion of the duodenum distal to the entrance of the common bile duct was resected.

Dragstedt, Dragstedt, McClintock and Chase¹⁷ studied the effect of duodenectomy in two series of dogs. In eleven dogs the operation was performed in two stages. At the first operation the pylorus was divided, both ends closed, and an anterior gastroenterostomy made with the middle jejunum. After the animals recovered from the first operation, a second was performed and the duodenum removed as far as the gastroenterostomy. The bile and pancreatic ducts were tied and the gall-bladder drained, in some cases into the jejunum, in others externally. Most of these dogs died within two or three days after the last operation; one lived twelve days. At necropsy a widespread, intra-abdominal fat necrosis was usually found. In one series of five dogs the common bile duct was ligated and sectioned, the pylorus divided, the pancreas opposite the pylorus ligated and divided with a cautery, and the entire duodenum with the adherent pancreas as well as the upper jejunum removed. The middle jejunum was sutured to the divided pylorus, and the gall-bladder drained. Most of these animals died on the fifth or sixth day, but one lived three weeks and one three months. The dog that survived three months, however, showed very marked nutritional disturbances and was kept alive for that period only by careful feeding and special attention.

Grey¹⁸ removed the duodenum in three stages, allowing an interval of several weeks between each stage. The first stage consisted of dividing the common bile duct between ligatures and anastomosing the gall-bladder to the proximal jejunum. After the animal had recovered, the second stage was performed. This consisted of isolating the major pancreatic duct and transplanting it into the jejunum a short distance from the site of the cholecystenterostomy opening. At the same time the minor pancreatic duct was ligated and sectioned. At the third stage the duodenum was removed.

Many animals succumbed at various stages of the operation, but one survived all three operations and lived in a normal condition for nine and one-half months after the total removal of the duodenum; it then died suddenly, apparently from intestinal obstruction following adhesions.

Moorhead and Landes¹⁹ also removed the duodenum of the dog in three stages. In the first stage the pylorus was sectioned, the duodenal end invaginated and closed and the proximal jejunum anastomosed to the gastric end. Two weeks later the common bile duct and major pancreatic duct were transplanted into the jejunum just distal to the gastrojejunal anastomosis. After another interval of two weeks the duodenum was removed. Only the mucosa was removed from the pancreatic portion of the duodenum. Dogs operated on in this manner lived in a normal state of health.

A few general statements are justified from this brief review of the data of previous workers on the effects of duodenectomy. As I have stated, the first investigators were interested in the problem only as it might affect the

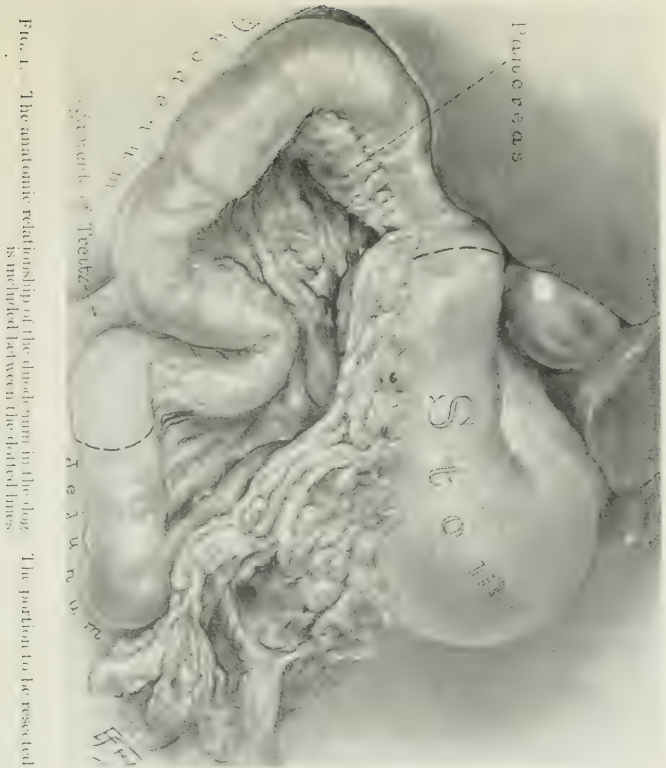


FIG. 1. The autonomic relationship of the duodenum in the dog. The portion to be resected is included between the dotted lines.

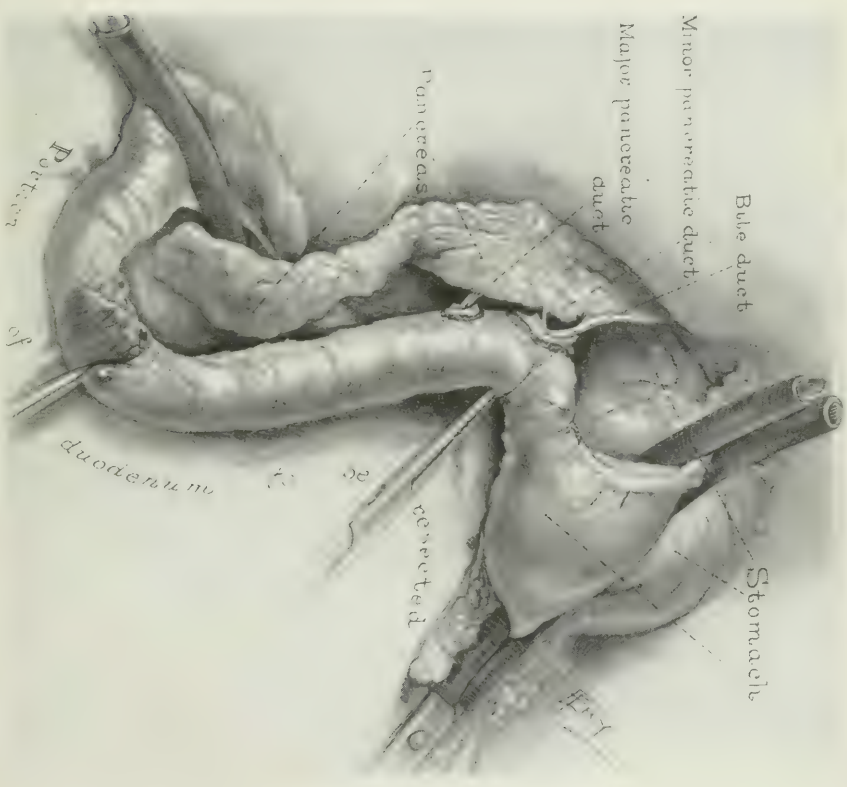


FIG. 2. The duodenum of the dog, before resection and after complete separation from its ligaments, blood vessels, and plexuses. The ducts are completely isolated and ready to be sectioned just as they pass through the incision of the duodenum.

The animal was fasted for twenty-four hours. Ether anæsthesia was employed and all operations were performed with aseptic technic. The duodenum was exposed through a right rectus or midline incision (Fig. 1). The duodenojejunal juncture was found and the duodenojejunal fold cut. The branches of the mesenteric vessels, usually three or four, which run to the distal duodenum and proximal jejunum, were doubly ligated and sectioned. This procedure mobilized the proximal portion of the jejunum. The mesoduodenum was cut to the point where the pancreas becomes adherent to the duodenum. In order that the subsequent gastrojejunal anastomosis might be performed with ease, the lesser omentum was partially divided; usually it was also necessary to ligate and section several blood-vessels.

The common bile ducts and the pancreatic ducts were located and exposed. The bile duct and minor pancreatic duct, together or close to each other, open into the duodenum from 5 to 8 cm. from the pylorus, and the major pancreatic duct opens from 2.5 to 5 cm. distally. After exposure of the ducts the duodenum was carefully but boldly dissected from the pancreas, beginning at the caudal end. The branches of the pancreatic-duodenal vessels which enter the duodenum from the pancreas were tied with fine silk or catgut ligatures and divided close to the former. The bile duct passes behind the duodenum, perforates the muscular coat of the latter, and, after running for 1 cm. or more in the submucosa, opens into the bowel, closely associated with the minor pancreatic duct. An aneurism needle was placed under the exposed portion of the duct, placing it on a tension. The muscular coat of the duodenum along both sides of the entire course of the duct was incised longitudinally with a small sharp-pointed scalpel and the duct perfectly isolated up to its orifice. The same procedure was repeated on each of the pancreatic ducts. At this point of the operation the duodenum was free with the exception of its attachment to the stomach and jejunum and to the bile and pancreatic ducts (Fig. 2). Various methods were tried of treating the orifices of the ducts. By far the easiest method consisted of excising and leaving a small ring of duodenal mucosa around the duct. Owing to the disturbance of the circulation this little piece of mucosa always appeared dark red, and it seemed reasonable to suppose that it would not live. However, since such a method involves a careful histologic examination of the orifice of the ducts at necropsy in order definitely to determine that no duodenal mucosa is present, it seemed best to devise a technic which would be free from such suspicion. In a few operations we followed the method of previous operators and thoroughly scraped off the mucosa. The serious objection to this method is that scraping the mucosa is liable to cause contamination. The method which was found most satisfactory, and which obviated the possibility of contamination and the danger of leaving duodenal mucosa, is as follows:

The muscularis of the duodenal wall is cut about 1 cm. from the opening of the duct in the bowel and pushed back, making a cuff around the duct which extends toward the lumen of the duodenum. The duct is then sectioned just at its point of entrance into the bowel. In this

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manner the lumen of the duodenum is not entered and duodenal mucosa is not attached to the ducts. The minor pancreatic duct can usually be freed with the bile duct. Rarely is it necessary to cut the former because of an anomaly in position. It is very important that during the manipulation the pancreas is kept warm and well protected from contamination and drying. All unnecessary trauma must be avoided. The vessels supplying the duodenal wall must be ligated and divided close to the duodenal wall. Many of the failures recorded by other

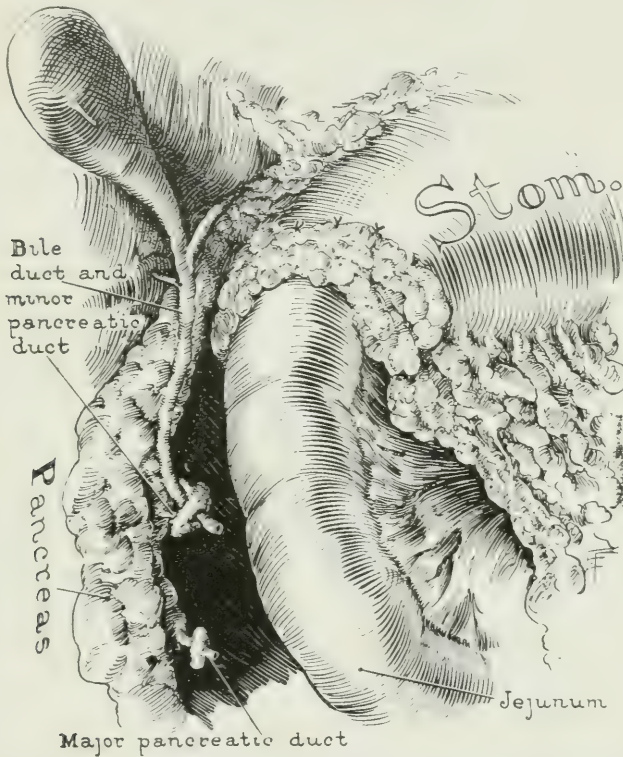


FIG. 3.—The duodenum resected and the jejunum anastomosed to the pyloric end of the stomach. The next step in the operation is the transplantation of the ducts. Note the cuff of muscle around each duct.

investigators and a few of our own have been due to trauma of the pancreas.

The next step in the operation is the removal of the entire duodenum. Rubber-covered clamps are placed on the stomach and the jejunum. The entire segment of the bowel from which the blood supply has been ligated is removed. This includes a segment of the pyloric region of the stomach (1 or 2 cm. proximal to the pyloric ring), the entire duodenum, and from 10 to 15 cm. of the proximal jejunum. The continuity of the intestinal canal is restored by direct anastomosis of the opened end of the stomach to the sectioned jejunum. Thus a segment of the jejunum occupies the exact site which had been occupied by the duodenum (Fig. 3).

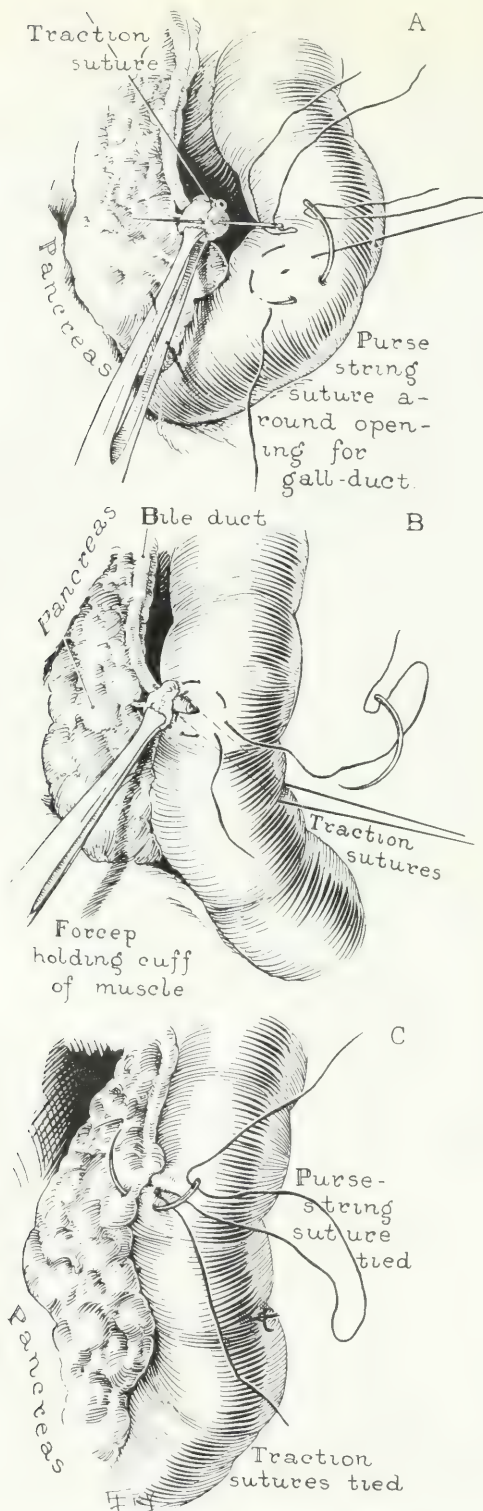


FIG. 4.—Steps in the transplantation of the ducts. A, traction and purse-string sutures in position. B, the duct being pulled into the jejunum. C, the transplantation completed.

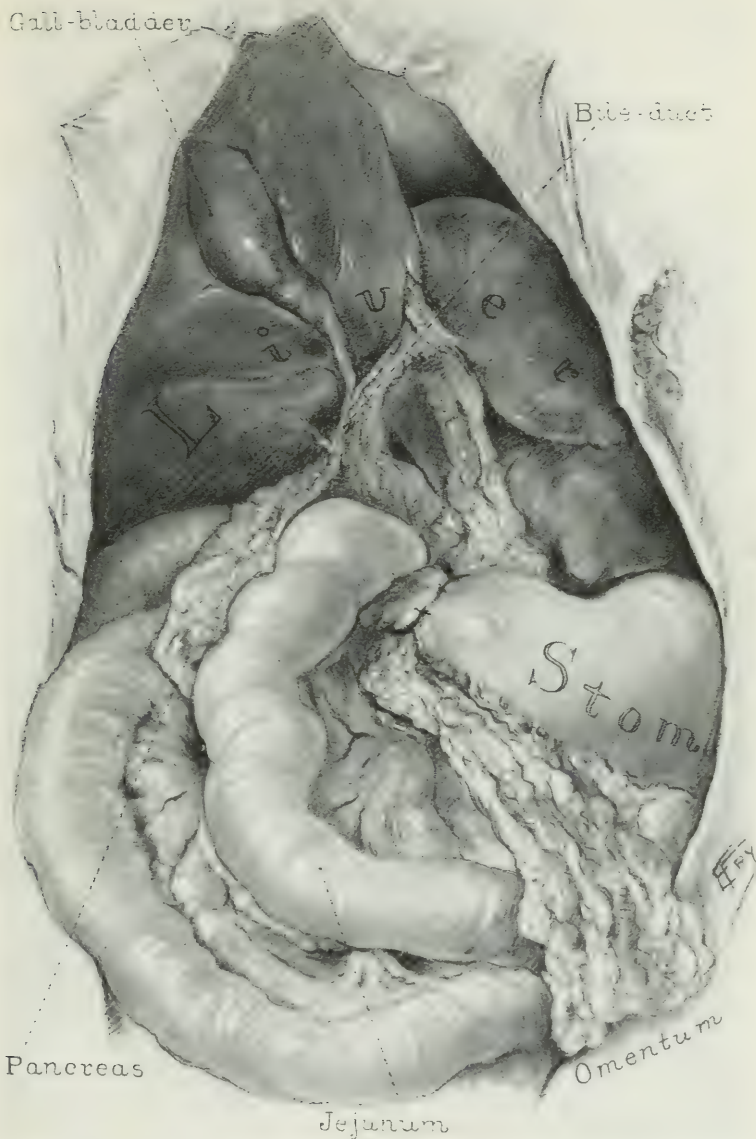


FIG. 5.—The operation completed in the dog. The jejunum occupies the position previously occupied by the duodenum. An almost complete reconstruction of the gastro-intestinal tract has been accomplished. The sites of transplantation of the ducts are marked by the indentation of the contour of the jejunum.

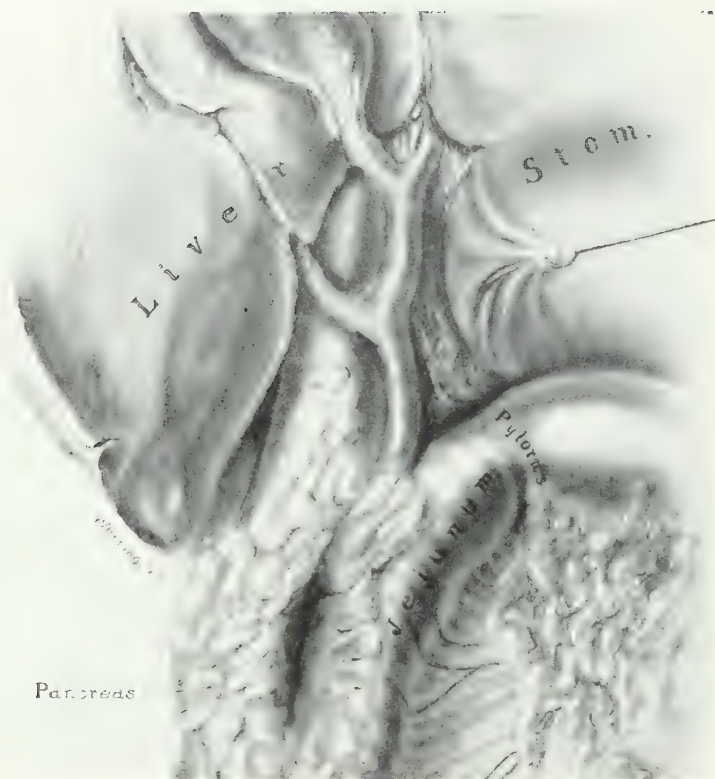


FIG. 6.—(Dog D. 37). The site of operation at necropsy 490 days after duodenectomy. Grossly the pancreas and liver appear to be normal. The extrahepatic biliary tract is slightly dilated and the walls thickened. The gastrojejunal anastomosis is hardly discernible. (Operation by Kawamura).

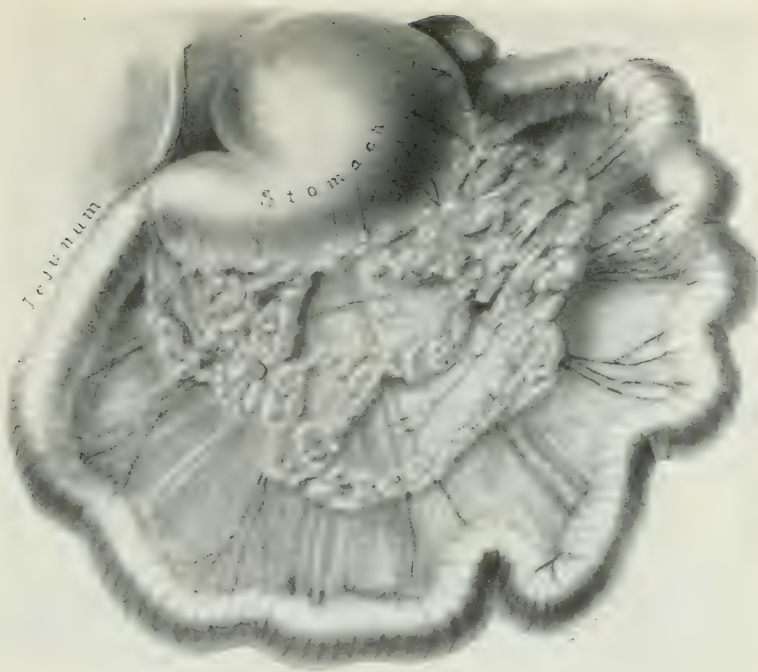


FIG. 7.—(Dog D. 37). The stomach and jejunum 490 days after duodenectomy. The chief evidence of the absence of the duodenum is that the loop of intestine proximal to the stomach has a free mesentery, that is, the ligament of Treitz is absent. (Operation by Kawamura.)

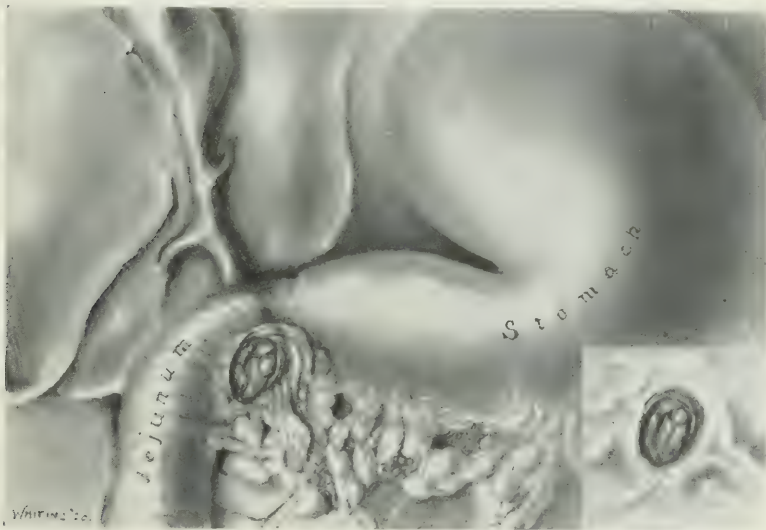


FIG. 8.—(Dog C. 991). A perforating ulcer on the jejunal side of the suture line which produced peritonitis and death 515 days after duodenectomy.



FIG 9.—(Dog C. 919). A deep ulcer on the jejunal side of the suture line, noted at necropsy, 393 days after duodenectomy. The ulcer had penetrated to the muscularis and had a hard base. The opening of the common bile duct is at a, the opening of the pancreatic duct at b.



FIG. 10.—(Dog C. 878). Duodenectomy two years and six months before. The animal appears the same as before operation.



FIG. 11.—(Hog 1). Thirty days after duodenectomy; animal weighs 27.5 kg. Compare with Figure 12.

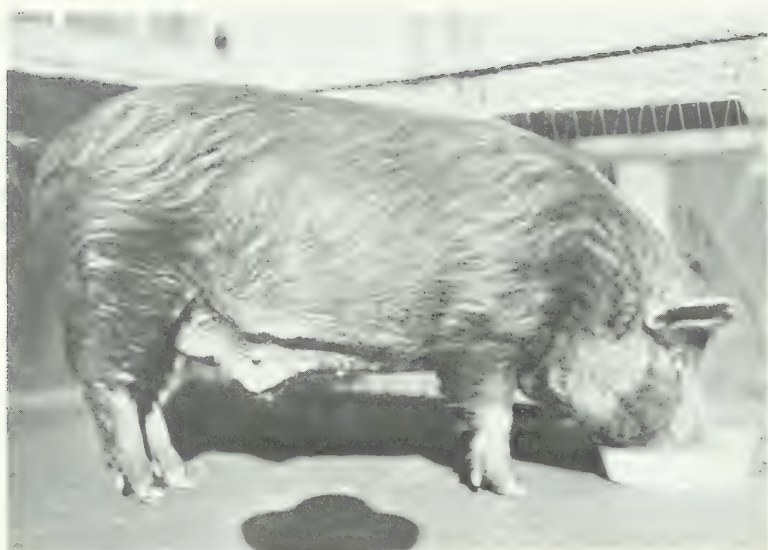


FIG. 12.—Hog 10. Three hundred two days after duodenectomy; animal weighs 130 kg. Compare with Figure 11.

The final step in the operation is to transplant the ducts. Two guides of No. 00 plain catgut threaded on straight cambric needles are attached on opposite sides of each duct (the minor pancreatic duct is included with the bile duct). A site on the wall of the portion of the jejunum which occupies the position of the duodenum is selected to prevent tension on the ducts. At this site, which is at about one-third the circumference of the jejunum from the mesenteric attachment, a purse-string suture of No. 00 catgut is placed. The purse-string forms a circle of about 8 mm. in diameter. With a sharp-pointed knife the centre is pierced and the opening enlarged by stretching with a sharp-pointed forceps to equal the diameter of the duct. Through this opening the needles of the guides are passed and pierce the opposite side of the bowel about 2 cm. below their entrance and about 0.5 cm. apart. The duct is drawn into the lumen of the jejunum and the guides tied. The purse-string suture is tied and, if necessary, a few additional sutures are taken and a tag of omentum sutured around the duct (Fig. 4). When this is finished the bowel is slightly constricted, but it is always patent for the passage of gas and liquids (Fig. 5). The constriction disappears when the fine catgut is absorbed. The muscularis which is left around the duct serves to plug the opening through which it has been drawn.

There are many possibilities for technical errors. In our experiments the failures have been due to: (1) too small an opening of the anastomosis of the jejunum to the stomach; (2) suturing the common bile duct too firmly in the intestinal wall, producing partial obstruction; and (3) trauma to the pancreas (this error only occurred in cats). It is interesting to note that we rarely had a failure of the transplantation of the pancreatic duct in this series of experiments.

RESULTS OF REMOVAL OF THE DUODENUM IN VARIOUS SPECIES OF ANIMALS

With slight modifications in the technic described, necessary because of anatomic variations in the different species of animals, the duodenum was removed from five species—dog, cat, hog, goat, and monkey. The best results were obtained in the dog, cat, and hog, and conclusions are based on the data obtained from the experiments on these three species.

The Dog.—Most of the experiments were performed on the dog and, since the technic was devised mainly for the dog, it was carried out exactly as described. Our observations included: (1) The general condition of the animal; (2) the movements of the gastrointestinal tract; and (3) the secretory activity of the stomach. We had also planned to study the secretion of the pancreas and liver, but as a few preliminary observations made it quite evident that the loss of the duodenum would not produce so great a change, if any, in the secretory activity of these glands, as the transplantation of their ducts, we did not make any extensive observations.*

We have not been able to show that the removal of the duodenum in the dog, unaccompanied by sequelæ of errors of the technic of the operation, in any way affects the life or general health of the animal except in relation

* Our observations on the secretory activity of the stomach are not completed.

to the possibility of ulcer. All the animals in which the operation was technically perfect remained in seemingly normal condition. The appetite was always good; the weight did not vary any more than in laboratory dogs not operated on; nothing was noted which could be attributed to the loss of the duodenum (Protocol 2).

A few of the duodenectomized dogs showed a steady loss of weight and strength after operation. At necropsy in these animals an error of technic in one or two points was noted. In some of the animals a dilated common bile duct and marked infection of the entire biliary tract were found. Evidently the transplantation of the ducts did not restore a sufficiently normal condition to prevent infection. In the others the anastomosis of the jejunum to the stomach was not of sufficient calibre to allow the stomach to empty correctly; consequently there were considerable gastric retention and dilatation.

The blood of some of the dogs was examined with regard to cell count, hæmoglobin, carbon dioxid combining power, and hydrogen ion concentration, before and after duodenectomy. No differences were noted which appeared to be owing to the duodenectomy.

In several of the animals the gastrointestinal tract and the passage of a standard barium meal were examined by means of the Röntgen ray. The method consisted of making observations and plates on the course of the standard barium meal two or three times before duodenectomy and at various times after. The barium meal consisted of equal parts of barium sulfate, saturated gum acacia solution, and condensed milk. Fifteen cubic centimetres for each kilogram of body weight of the solution was administered by stomach tube. Observations were made immediately after the administration of the meal and at definite subsequent periods until the meal had passed through the animal.

In general, noteworthy differences were not noted in the passage of the standard barium meal before and after duodenectomy. In most animals the meal started to leave the stomach sooner after duodenectomy than before. This was attributed to the loss of the pyloric sphincter. In a few of the animals the stomach emptied slightly faster after operation than before and in a few others the emptying was delayed. In all cases the changes were slight and did not seem to differ from the slight changes noted by repeated observations on normal dogs. Of course it is possible that if various types of meals had been administered, differences might have been noted. The picture of the gastrointestinal tract always appeared to be normal. A few preliminary observations in the secretory activity of the stomach after duodenectomy were made. No noteworthy change was found.

The Cat.—The duodenum is easily removed from the cat, but the operative results are not good. The technic was the same as that used in dogs. Most of the cats recovered from the immediate effects of the operation but did not do well and died within a few days. At necropsy the cause of death usually seemed to be trauma to the pancreas; in no instance could death

be attributed to loss of the duodenum. One of the cats recovered and appeared normal for 168 days, when it died from an intercurrent disease. From this one complete experiment we can definitely state that duodenectomy is compatible with life and health in the cat (Protocol 3).

The Hog.—The hog was selected as an omnivorous type of animal. Duodenectomy is difficult in this species. The bile and pancreatic ducts empty separately. For expedience and in order to remove all the duodenum, it was found best to section the intestine at the duodenojejunal juncture, invert the end of the jejunum, and unite the jejunum slightly more distally to the end of the stomach. The operation was performed on only one hog, and the success and results of the experiment did not seem to warrant further investigation in this species. The animal recovered from the operation.

DISCUSSION

This brief review of our experiments readily shows that the duodenum is not necessary for life, and the fact that noteworthy changes were not observed makes it appear that its function does not differ greatly from that of the rest of the intestinal tract.

Only one positive finding was obtained in the entire series of experiments. In two of the dogs a large ulcer was found on the jejunal side of the suture line of the gastrojejunal anastomosis. In one of the animals the ulcer perforated, causing peritonitis and death (Dog C, 991, Table I and Fig. 8) 515 days after duodenectomy. The other animal came to necropsy 383 days after duodenectomy and a large ulcer with a hard base was found (Dog C, 919, Table I and Fig. 9).

Eleven duodenectomized dogs were kept under observation for from ten to thirty months. One of these is still alive. Of the ten coming to necropsy, two had ulcers. Since peptic ulcer of the subacute or chronic type is very rare in the dog, this seems significant.²⁰

At the suggestion of Dr. C. H. Mayo we are making a more comprehensive study of the effect of duodenectomy in relation to gastric secretion, and are also studying the possible function of Brunner's glands. From these studies we hope to determine the reason for the presence of these ulcers.

SUMMARY

The investigation was undertaken for the purpose of determining the effect of removing the duodenum. A one-stage operation for removal of the duodenum was developed. The duodenum was removed from the dog, cat, hog, goat, and monkey, although long-continued observations were made only on the dog, cat, and hog. Careful studies on these three species did not reveal any noticeable changes following the duodenectomy. In the dog observations were carried on more than two and one-half years after operation. The animals remained in good condition. No data have been secured to show that the duodenum is of great importance in any of the species studied. However, in two of the ten dogs studied a typical peptic ulcer occurred on the jejunal side of the gastrojejunal anastomosis. Whether

this bears any relation to the loss of the duodenum or any specific part of it, as Brunner's glands, is to be determined.

PROTOCOL 1.—*August 7, 1918, Experiment 552, Dog C 673, an adult female bull terrier, in good condition, weighing 14.3 kg.* Under ether anæsthesia a two-stage operation in one stage was attempted. The pancreatic ducts were traumatized, which necessitated ligation. The duodenum was removed and an end-to-end anastomosis between the jejunum and the stomach made, and the bile drained by a cholecystenterostomy.

The animal recovered from the immediate effects of the operation and remained in fair condition for forty-one days and then died. The cause of death was not determined, but probably it was partially associated with the ligation of the pancreatic ducts.

PROTOCOL 2.—*December 11, 1918, Experiment 892, Dog C 878, a male mongrel shepherd, weighing 20.7 kg.* The duodenum was removed at a single operation. The animal recovered from the operation and remained in excellent condition.

December 31, 1918, the animal was in good condition—its weight was 19 kg.; it remained in good condition. January 8, 1919, its weight was 17.9 kg.; January 14th, 19.9 kg.; January 28th, 19 kg., and February 18th, 19.8 kg. July 3rd the animal was fat, its weight was 21.2 kg.; December 19th, one year after operation, the animal was in good condition—its weight was 18.3 kg.; January 6, 1920, 21.4 kg.; March 4th, 20 kg.; June 4th, 20.2 kg.; July 30th, 19.3 kg. The animal remained in good condition for several months longer and then lost slightly in weight. December 12, 1920, it weighed 16.4 kg., but it soon recovered normal weight. June 30, 1921, two and one-half years after duodenectomy, it was in excellent condition and weighed 20 kg. (Fig. 10).

PROTOCOL 3.—*November 1, 1919, Experiment 747, Cat 173, a male adult in good condition, weighing 2415 gm.* A very fine silk was used for all sutures except for the purse-string suture in transplanting the ducts. Only the pancreatic duct, and the common bile duct, which empty together, were transplanted. The animal recovered from the operation and remained in excellent condition for many weeks.

In March, 1920, it developed distemper. Following this it lost some weight, but remained in fair condition, although it coughed considerably and had a chronic nasal discharge. Pneumonia developed, and the animal died May 7th.

Necropsy was performed shortly after death. Both lungs were markedly involved by the pneumonic process. The site of operation was in good condition. The common bile duct was slightly dilated. Grossly the pancreas was normal. Effect of the operation could not be discerned either grossly or microscopically.

PROTOCOL 4.—*June 10, 1919, Experiment 359, Hog 1, a Duroc-Jersey male, approximately six months old.* The animal was decidedly a runt, weighing only 23.4 kg.; otherwise it was in excellent condition. The technic used in the dog was attempted. The operation was very

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difficult. The mesentery was too short to allow the direct anastomosis of the end of the jejunum to the pylorus, so that the jejunum was sectioned at its point of origin and the end united to the pylorus by an end-to-end anastomosis. The transplantation of the common bile duct and the pancreatic duct, which are separate in the hog, was accomplished with considerable difficulty.

The animal was quite sick for the first few days, but soon recovered from the immediate effects of the operation. Bile appeared in the urine and the scleras had a slight yellow tinge. The stools showed evidence of lack of bile. After the first week the animal's appetite became normal, bile disappeared from the urine and the stools gradually returned to normal.

May 24, 1919, the animal was practically normal; it weighed 25 kg.

June 20th, the animal was in good condition; it weighed 27.5 kg. It was then sent to the farm where it grew and developed normally. It was kept under daily observation, but no detailed data were recorded. It was fed moderately but never given a full fattening meal.

November 6, 1919, the animal weighed 95.5 kg.

February 26, 1920, the animal weighed 130 kg.

February 27, 1920, the animal was killed, and necropsy performed immediately. The animal was in good condition, moderately fat, but not nearly so fat as it could have been if a heavier feed had been given. The incision was marked by a faint scar. On opening the abdomen a few rather dense adhesions were found at the site of operation; otherwise it was in excellent condition. The biliary tract, however, seemed to be infected and a few small stones ranging from 2 mm. to 4 mm. in diameter were found scattered throughout the liver. The pancreatic duct transplantation had been a partial failure because a portion of the pancreas was infiltrated with fat, although there were large areas of pancreatic tissue interspersed throughout the fat. Grossly and microscopically all other organs were normal. Microscopically the liver showed few pathologic changes and the remaining pancreatic tissue was normal (Figs. 11 and 12).

POST-OPERATIVE COURSE OF TEN DUODENECTOMIZED DOGS

Animal	Length of life after duodenectomy	Cause of death
	Days	
Dog C 750	325	Etherization.
Dog C 729	327	Obstruction resulting from adhesions around an infected silk suture at the site of the intestinal anastomosis.
Dog C 802	372	Volvulus of large intestine.
Dog C 991	515	Peritonitis following perforation of ulcer at site of intestinal anastomosis.
Dog D 37	490	Etherization.
Dog D 38	556	Results of another experiment.
Dog D 39	555	Results of another experiment.
Dog C 919	393	Results of another experiment.
Dog D 86	480	Etherization.
Dog D 339	555	Etherization.

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A COMPARATIVE ANALYSIS OF 213 FOREARM AND LEG FRACTURES

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THE following remarks are the result of the study of cases and skiagrams of simple forearm and leg fractures due to accidents of the street, home life and sporting fields. The causes of these accidents were as follows:

Forearm: Back-fires, thirty-seven cases; fall (staircase, on hand), twenty-five cases; fall from horses, five cases; kick by horses, one case; cycling accidents, five cases, foot-ball accidents, four cases; boxing accidents, two cases; cricket accidents, one case; knocked down by vehicles, three cases; unknown, twenty-two cases. Total, 105 cases.

Back-firing of motors appears to be the commonest cause of forearm fractures in this series. The word "fall" includes a variety of mechanisms, such as: "slipping" in the hand, fall from a height, fall downstairs, etc.

The ages of these individuals were distributed as follows:

Between ten and twenty years, forty cases; between twenty and thirty years, thirty-seven cases; between thirty and forty years, fourteen cases; between forty and fifty years, six cases; over fifty years, eight cases. Total, 105 cases.

The distribution of the single *radial* fractures was as follows:

The radius alone was broken in seventy-four cases; the radius and ulna together were broken in sixteen cases; the ulna alone was broken in fifteen cases. Total, 105 cases.

The distribution of the single *radial* fractures was as follows:

Head, five cases; middle third, one case; lower third—upper half, twelve cases; lower half, fifty-six cases. Total, seventy-four cases.

These figures show the lower end of the radius to be the commonest level of fracture (Fig. 1) and the lower half of the lower radial third the point of greatest weakness of the bone to trauma. In fact, the lower radial third was fractured in fifty-four per cent. of the total number of forearm fractures. The transverse line is the commonest direction of the radial fractures, the oblique direction the next common, and the vertical crack the rarest (Fig. 1, Fig. 64). The great majority of these fractures are complete through the bone. The incomplete or greenstick are more common at the upper half of the lower third. The edge of the head was split obliquely in three cases and the neck transversely in two cases. The middle radial third was broken across in a single case, as the result of a boxing punch.

The distribution of the single *ulnar* fractures was as follows:

Upper third (olecranon), six cases; upper third (coronoid), two cases; upper third (below coronoid), two cases; middle third, two cases; lower third, three cases. Total, fifteen cases.

These facts demonstrate the upper ulnar end to be the commonest seat of fracture (Fig. 2) and the olecranon the part of the ulna most frequently injured. In three cases the olecranon fracture was incomplete. In one case of complete fracture of the base of the olecranon there was comminution and separation of the fragments. In two cases of through fracture of the

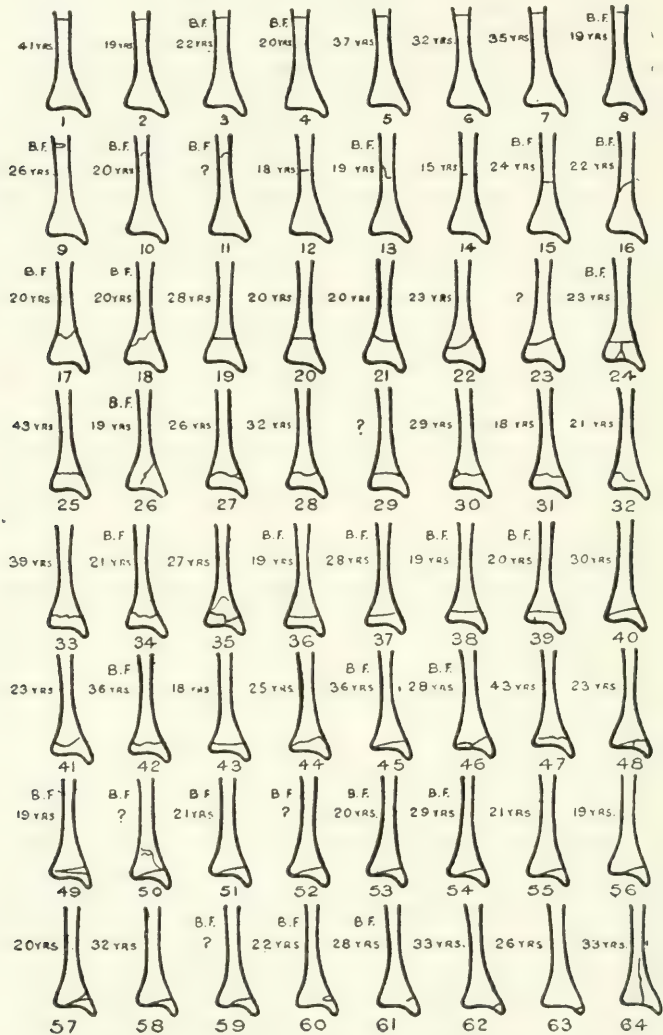


FIG. 1.—(a and b) Shows sixty-four single fractures of the lower third of the radius. Those marked B.F.—30 all are due to back-fire. The ages of the cases are indicated as well.

apex and base of the olecranon there was no diastasis of the fragments. In two cases of fall on the hand, the coronoid was broken at its beak.

If the two last tables are compared it is obvious that the lower radial and the upper ulnar ends are the two most vulnerable seats of these bones

to trauma. In fact, the olecranon was fractured in forty per cent. of the single ulnar fractures, and the lower half of the radial lower third in seventy-seven per cent. of the radial single fractures.

The tip of the ulna styloid process appeared broken in thirteen per cent. of single fractures of the ulna, and the radial styloid in five per cent. of single radial fractures. These were cases of so-called "sprained wrists." It must be remembered that the "*os triquetrum secundarium*," and the "*intermedium antebrachii*," which sometimes appear in skiagrams of the wrist, may be taken for a fracture. The "*os radiale externum*" occupies a much lower position in relation to the radial styloid, as I have shown in other articles.

In one case the lower ulnar end was fractured in a spiral fashion.

The distribution of the combined *radial* and *ulnar* fractures was as follows: Radius: Upper third, three cases; middle third, two cases; upper half, five cases; lower half, six cases. Ulna: Upper third, four cases; middle third, one case; upper half, two cases; lower half, nine cases. Total, sixteen cases.

These figures show the lower radial and ulnar third to be the commonest seat of fracture. The olecranon and the radial head were not broken in any of these cases, but the external lip of the coronoid appeared fractured in a backfire case (Fig. 3, Fig. 1).

The relative level of the line of fracture, taking the level of the radial fracture as the basis for comparison, was as follows: Ulnar fracture below the radial, seven cases; ulnar fracture above the radial, three cases; ulna fracture level with the radial, six cases. Total, sixteen cases.

The distance between the two levels appears to be greater when the ulna is broken above the radius, the widest distance being in a case of backfire, when the radius was broken at the lower third and the ulna was fractured at the coronoid brim (Fig. 3, Fig. 1). In one case the fractures of the ulna and radius were comminuted.

If the radial and ulna single fractures and the radial and ulna combined fractures are analyzed, it will be found that the lower radial end and the upper ulnar end are the most commonly involved parts of these bones. The middle third of the radius and ulna was fractured in three per cent. of the total number of forearm fractures. The fracture of the ulnar middle third was accompanied by luxation forwards of the radial head which appears to be the rule in these cases. In the fractures of both ulna and radius the former is usually broken below or at the same level of the radial fracture.

Relationship between the injury and the kinetoplastic effect on the bone: Backfires or chauffeur's fracture (Figs. 1 and 3). This forms a very important group of forearm fractures. There were thirty-seven authentic cases distributed as follows: Radius and ulna, six cases (Diag. 3, Figs. 1 to 6); ulna alone, no cases; radius alone, upper third, one case (Diag. 3, Fig. 7); radius alone, middle third, no cases; radius alone, lower third, upper third, six cases (Diag. 1, Figs. 3, 4, and 8 to 11); lower third, middle third, four cases (Diag. 1, Figs. 13 and 15 to 17); lower third, lower third, twenty cases

(Fig. 1, Figs. 18, 24, 26, 34, 36 to 39, 42, 45, 46, 49 to 54, and 59 to 61). Total, thirty-seven cases.

These interesting figures show the lower radial end to be the most frequent seat of "chauffeur's fracture" (Fig. 1, all figures marked B. F.). The neighborhood of the epiphyso-diaphyseal line is, on the other hand, the most common level of the fracture, as it was broken in fifty-four per cent of back-fire cases. The upper part of the radial lower third is often fractured incompletely; in fact, two cases out of six were of the greenstick variety. The age of the case bears no relation to the level of the fracture.

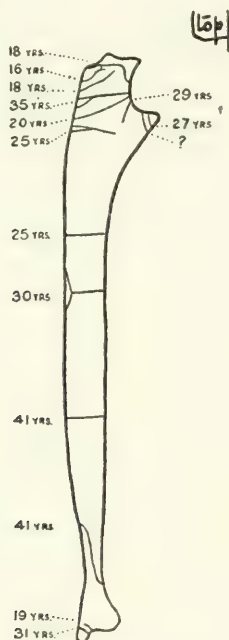


FIG. 2.—Shows fifteen single fractures of the ulna.

The common direction of the radial fracture is usually transverse or slightly oblique from within outwards. The radial styloid process was fractured in one case only. The inner lip of the radial head was fractured in another case (Fig. 3, Fig. 7) and clinically there was some local pain while rotating the radius. The edge of the outer side of the coronoid brim was broken in another case (Fig. 3, Fig. 1,) but this fracture was accompanied by fracture of the radius at the junction of its middle and lower thirds. The two last-mentioned fractures appear to depend on the degree of flexion of the elbow and the time at which the hand is struck by the handle of the motor. It is necessary to think of the multiple angles the wrist, forearm and arm form between themselves in imparting rotatory movements to the motor, to understand the side which will give way. It appears that the radial head fracture depends on the degree of forearm flexion at the elbow, and the side

of the capitellum split on the degree of forearm pronation. The ulna coronoid fracture, on the contrary, depends on the degree of forearm extension at the elbow, and the extent of arm abduction.

The two forearm bones were fractured in sixteen per cent. of back-fire cases (Fig. 3, Figs. 1 to 6). In two cases the ulna was fractured in a spiral fashion. In five cases the lower radial and ulnar thirds were fractured, as shown in the Fig. 3, and in one case only the coronoid brim was split as already mentioned. The upper two-thirds of the radius and ulna were, in this series, free from injury due to back-firing, with the exception of the edges of the coronoid and radial head. The carpal and humeral injuries that I have met with, due to back-firing, are not mentioned in this paper.

I have tried to find out whether the cases kept the pollex under or above the handle while starting the motor, or if the handle was grasped from above. It appears that the former position is a safeguard, although a few cases have met with the fracture in spite of that precaution. The grasping of the handle from above is not well known by these individuals. I could not, on the other

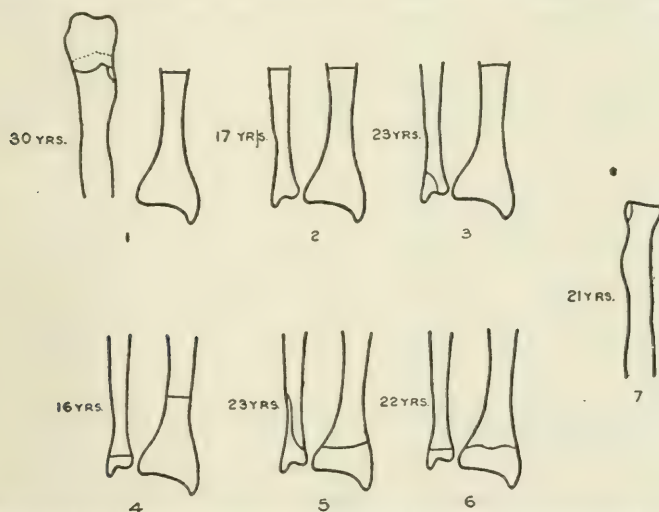


FIG. 3.—Shows some back-fire fractures. Figures 1 to 6 being fractures of both forearm bones, and figure 7 a single fracture of the radial head. Note figure 1 a fracture at the junction of the middle and lower radial third and outer brim of the coronoid process of the ulna.

hand, come to a definite conclusion regarding the type of engine which more commonly originates these fractures. Want of experience on the part of the drivers can hardly be adduced, as the majority were men long used to driving. There was no case of recurrence among these fractures.

It is difficult to explain why some of these cases should have one or the two forearm bones fractured. The reason appears to be the position and amount of wrist abduction at the time of the back-firing.

Lavermicocca suggested that these chauffeur fractures were due to an effort of "taglio." Some of the back-fire fractures mentioned in this article have not yet been described in the literature (Sir G. Beatson, Caccia, Faur, Ghillini, Lucas-Championniere, Lund, Maximovich . . .).

The so-called *epiphysial strain* and the fractures of the radial lower end form an interesting clinical subject. In this series, there were six cases of epiphysial separation, as follows: four cases were due to back-fires and two to fall on the hand. The ages of the former were: Two of nineteen years, one twenty-two years; one thirty-six years (Fig. 1, Figs. 36, 38, 42 and 60); of the latter fourteen and fifteen years. In four cases there was complete separation of the fragments, and in two there was only widening of the radial epiphysis at its outer end for one-fourth and half of its width. The swelling is diffuse and there is an ecchymosis at the front or back of the wrist, whereas in the cases of so-called sprain there is no ecchymosis and the pain is not localized and appears to shoot along the back of the forearm towards the elbow. On pressing the bone the pain is referred to a diffuse area and is not localized to the styloid line as in fracture. I was not able to find the small, localized area of swelling Speed refers to in his paper.

There were four cases of *reversed Colles* or *Goyrand fracture*. Two cases of nineteen and twenty-eight years of age were due to back-fire. There was a case of fourteen years who fell on the hand, and the last of forty-three years of age met with this fracture by falling on the hand with the fingers and wrist flexed. The physio-pathology of the Goyrand fracture is a matter of some difficulty. In the case of chauffeur's fracture of this type, either there is a direct hit, or the injury takes place while the hand and wrist are dragged upwards by the sudden upper stroke of the handle.

If the causes of the other fractures are analyzed it will be found that an apparent similar trauma does not produce a regular and systematic identical type of fracture. For instance, the terms fall on the hand, torsion of the forearm, etc., include a great variety of forces which render such classification very obscure. The compression theory of Stevens, referring to the lower radial end, explains the physio-pathology of these fractures, which are, after all, the commonest in the upper limb. The hyperextension of the wrist is one of the primary reflexes of the limbs. It is well displayed in the mammalian series, and constitutes the attitude of the wrist assumed by men in a fall. Experimentally, it has long been proved that dorsal flexion, or the rarer palmar flexion, are followed by fracture of the radius at its lower end (Brossard, Cotton, Hamilton, Pilcher). This fact fits in with the theory.

The *olecranon fractures* (Fig. 2) result either from direct trauma: striking the elbow against an object, impact of a falling body on the elbow, etc.; or, of a fall combined with some sudden and violent forearm flexion. It is difficult to find out why some of these cases show complete separation, while others are only completely or incompletely broken without exhibiting any marked anatomical deformity. It seems that the intensity of the injury, and the degree of development of the triceps and tricipital fascia, are the anatomical factors which explain these varieties of clinical conditions. The *fractures of the coronoid* occurred in men beyond twenty-four years of age, and were due to falls on the hand in a motor collision and in a bicycle accident. In neither was there any evidence of direct trauma. The five radial

ANALYSIS OF 213 FOREARM AND LEG FRACTURES

head and neck fractures occurred in cases nineteen, twenty-one, twenty-three, thirty and thirty-one years of age, and were due to a fall on the hand from a height, back-fire (Fig. 3, Fig. 7), thrown off top of bus and fall on the open

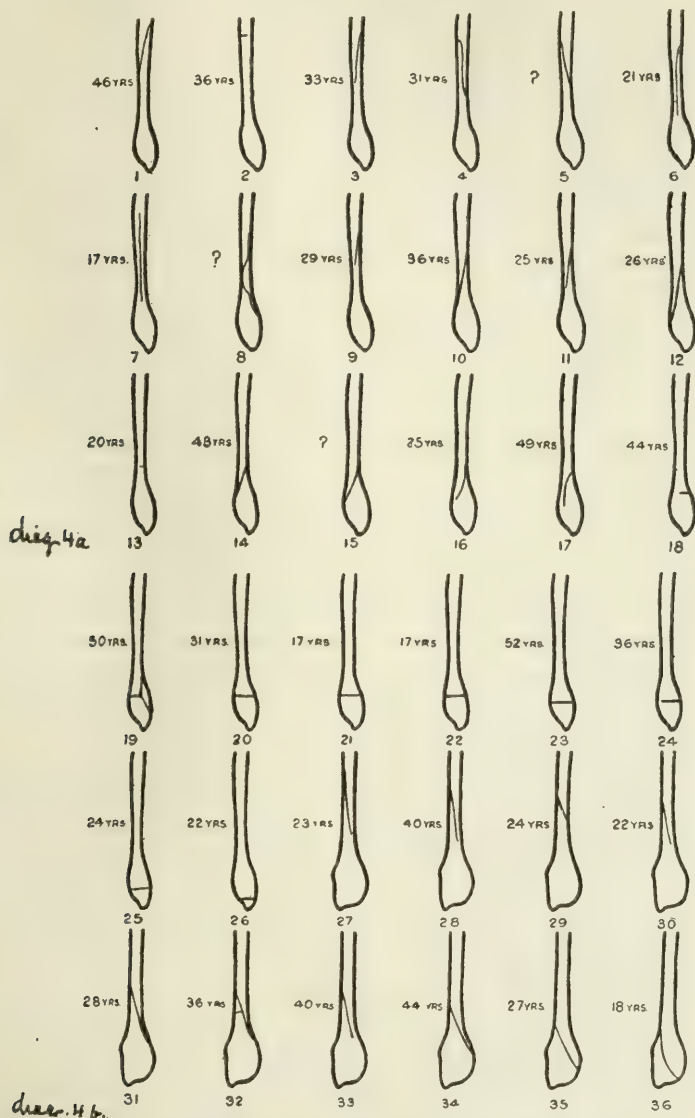


FIG. 4.—(a and b) Shows thirty-six single fractures of the fibular lower third. Figures 1 to 26 are antero-posterior, and figures 27 to 36 lateral views of the bone. Figure 7 is a good example of a medullary split. Figures 26 to 36 show the direction of the fracture to run downward and forward.

hand, cycle accident, and a fall from a height. These fractures are confined to the area of the bone above the bicipital tuberosity, and it is interesting to note that the line of the crack is almost always longitudinal, which appears to show that it is due to the impact of the bone against the humeral capitellum.

The single forearm fractures due to indirect trauma are better understood if the two bones are considered as a single structure. This fact, roughly speaking, appears in some mammals as a feature of their skeletons (horses, deer . . .). In the case of the human fractures, the upper segment of the ulna and the distal third of the radius should be thought of as the ends of these combined theoretical bone.

The middle of the radial shaft, and the middle of the ulnar shaft were fractured in three cases and due to direct trauma. Fracture of both bones at the upper two-thirds occurred in four cases. It will be interesting to find out whether these double fractures occur simultaneously, or if one bone follows the other, much in the same way as the radial head slips forward over the humeral capitellum, having lost, as it were, the support following the mid-ulnar fracture.

With reference to the direction of the fragments it appears that the subperiosteal fracture of the radius usually shows an angulation forwards. The upper radial segment appears to have a tendency to point inwards. The ulnar fractures show the lower segment pointing more commonly outwards. In fact, the action of the supinators at the upper half and the pronators at the lower half of the forearm, seem to explain the direction of these deviations, and this is well explained in Whipple and St. John's paper.

In a case of longitudinal spiral fracture of the lower ulnar end there was a fracture of the fifth metacarpal base; in another case the tip of the radial styloid fracture was associated with fracture of the scaphoid neck. This was not a case of "naviculare bipartium," since the gap between the fragments was wide and irregular, and there was clinical evidence of trauma. In one case a complete fracture of the olecranon was associated with fracture of the humeral epitrochlea.

There were four cases of *longitudinal or "medullary" cracks of the radius* (Fig. 1, Figs. 35, 50 and 64) as follows: Man, thirty-three years old, who twisted the forearm while playing foot-ball; two men twenty-three and twenty-seven years of age, who fractured the radius starting a motor-car; in the fourth age and history were unknown. These splits appeared at the lower radial end and in two cases had a very irregular distribution. These medullary splits were not seen in the shafts of the radius or ulna. Parrish and Bendell cases were similarly distributed.

It is noticeable the apparent rarity of the so-called Colles' fracture, so well described by this surgeon as taking place at "about an inch and a half above the carpal extremity of the radius." In these series there were three cases that presented the classic features of this fracture and in one the impaction required forcible wrenching before the reduction of the fragments was obtained.

There were not in this series any cases of *marginal fractures* of the radius (Rhea-Barton and Letenneur type). The posterior edge of the lower radial diaphyseal end was broken in a wedge shape in a boy eighteen years old, who fell on the hand, having been thrown off a horse. The ulnar and radial

epiphyses were wider than usual, and there was at the anterior fourth of the radial diaphyseal end, a short vertical split for five millimetres. In the case of another patient fifteen years old, who fell on the hand, there was some widening of the epiphysis, and a short vertical split at the end of the diaphysis of both radius and ulna. These diaphyseal splits are apparently due to the compression force of the injury. In another case of a boy fifteen years old, and who fell from a horse on the hand the epiphysal line of radius and ulna appeared wider than usual in the skiagram, and clinically the case resembled a real case of epiphysal diastasis. The clinical differentiation between the so-called "separation of the epiphysis," widening of the epiphysal line and epiphysal strain, is an important matter from the prognostic standpoint.

Leg—Causes of Fracture: Slipped, twisted, sprained ankle, twenty-five cases; fall, twenty-one cases; fall from horses, four cases; cycling accidents, nine cases; foot-ball accidents, seven cases; cricket accidents, one case; tobogganning accidents, one case; knocked down by vehicles, eight cases; kicked by horses, eight cases; fall off wall, and barrel on leg, two cases; unknown, thirty-two cases. Total, 118 cases.

Slipping on the foot, slipping and twisting the foot are common occurrences among these cases.

The ages of these cases were distributed as follows: Between ten and twenty years, nineteen cases; between twenty and thirty years, thirty-six cases; between thirty and forty years, twenty-seven cases; between forty and fifty years, eighteen cases; between fifty and sixty years, nine cases; between eighty and ninety years, one case; unknown, eight cases. Total, 118 cases.

The distribution and sites of the fractures were as follows: The fibula and tibia together were broken in fifty-two cases; the fibula alone was broken in forty-two cases; the tibia alone was broken in twenty-one cases; the fibula and tibia together were broken in several places in four cases. Total, 119 cases.

Fracture of both legs occurred in one case. The combined tibia and fibular fractures are the commonest, as they occur in forty-seven per cent. of the total number of cases. The fibula is the next common, as it was fractured in thirty-eight per cent.

The distribution of the single *fibular* fractures was as follows: Upper third, one case; middle third, four cases; lower third, upper third, three cases; lower two-thirds, thirty-four cases. Total, forty-two cases.

The lower two thirds of the fibular lower third are the most vulnerable part of the bone to trauma (eighty per cent.) (Fig. 4). The commonest direction of the fracture is oblique from before backwards and upwards. Although the transverse split is commoner at the very lower end of the bone. The former type of injury is very commonly only seen by means of the lateral skiagram (Fig. 4, Figs. 27 to 36), and often missed clinically. In fact, these oblique cracks are a good skiagraphic picture of some clinical types of "sprained ankle."

The longitudinal splits at the centre of the diaphysis are very common in the fibula. In fact, these longitudinal or medullary splits appear at any level,

with a marked prevalence, however, for the middle third of the bone. I suggest the name "medullary" as these cracks run along the medullary clear space of the bone.

Thirty-eight per cent. of the fibular malleolar fractures were of the incomplete variety.

The distribution of the single fractures of the *tibia* was as follows: Upper third, outer tuberosity, two cases; upper third, tibial tubercle, two cases; middle third, two cases; lower third, upper third, eight cases; lower third (malleolar), seven cases. Total, twenty-one cases (Fig. 5). The lower

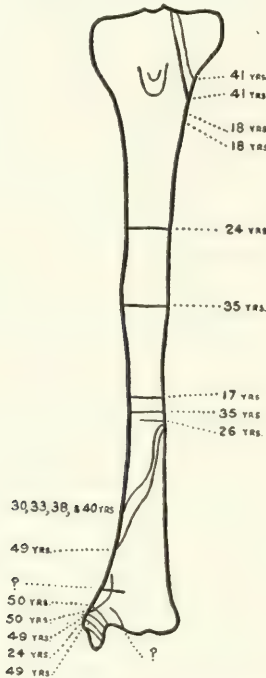


FIG. 5.—Shows twenty-one single fractures of the tibia. Those corresponding to the age of eighteen are fracture-separation of the tibial tubercle.

tibial third is the commonest level of fracture. The upper third part of the lower third showed eight fractures, of which four were of the spiral type. This fact forms a peculiar feature of the tibia from the traumatologic standpoint. The malleolar region was fractured as shown in Fig. 6. The distribution of the fractures at the upper tibial third is rather interesting. The outer tuberosity was vertically split in two cases of men both forty-one years old. The tibial tubercle was partially detached in two cases eighteen years old.

The distribution of fractures of the *fibula* and *tibia* together was as follows: Fibula—upper third: *upper half*, three cases; *lower half*, seventeen cases; middle third, ten cases; lower third—*upper half*, twelve cases; *lower half*, ten cases. Tibia—upper third: *upper half*, one case; *lower half*, one case; middle third, four cases; lower third—*upper half*, thirty-three cases;

lower half, thirteen cases. Total, fifty-two cases. The lower tibial third was fractured in eighty-eight per cent. of these double cases. The upper half of the lower tibial third appears to be the most fragile part of the bone, and of the thirty-three cases sixteen were of the spiral type. The spire usually ran from within outwards and upwards, in varying lengths, and rarely more or less vertically and in a large area of the bone. In one case it extended along the complete lower third and part of the middle third. In seventeen cases the fracture was seen transversely across the bone. In three cases the tibial malleolus was completely broken across. In one case of a man forty-four years old, and who twisted his foot in a railway collision, the tibial malleolus was fractured subperiosteally and the line of the crack extended in a V-like fashion along the lower third of the shaft (Fig. 6, Fig. 6). It appears that the tibial lower third behaves in these fractures almost identically as when fractured by itself. The anterior edge of the lower articular end of the tibia was broken in two cases (Fig. 6, Figs. 13 and 14), and the posterior edge in two cases as well (Fig. 6, Fig. 12). These marginal fractures appear to have occurred at the centre part of the articular brim, and near the fibular side. The middle third of the tibia was fractured in four cases, and in one case the fracture was of the spiral type. The upper tibial third was split transversely in two cases. This fact was not seen when the tibia was fractured alone.

The fibular upper and lower thirds are the two commonest seats of fracture. The former was broken in thirty-eight per cent. and the latter in forty-two per cent. of these double cases. This shows a slight discrepancy, compared with fractures of the fibula alone. Very often the split is of the medullary type.

The relative level of the line of fracture, taking the level of the tibial fracture as the basis of comparison, was as follows: Fibular fracture below the tibial fracture, four cases; fibular fracture above the tibial fracture, thirty-four cases; fibular fracture level with tibial fracture, fourteen cases. Total, fifty-two cases. In sixty-five per cent. of these cases the fibula was broken above the tibial level of fracture. The widest distances between the two fractures being: (a) Transverse fracture at the junction of the middle and lower tibial thirds, and the tip of the fibular head due to a fall on the foot; (b) incomplete fracture of the tibial malleolus and medullary split of six centimetres along the middle third of the fibula, in a girl who fell and twisted the leg (Fig. 6, Fig. 10, etc.).

The spiral fractures of the tibial lower third were accompanied by fracture of the lower part of the fibular upper third in twelve cases out of sixteen. In two cases of these spiral fractures of the tibia, the fibular fracture accompanying it was at the middle third of the bone. In one case the fibular fracture was at the middle of its upper third, and in another the fibula was fractured four centimetres above its lower tip. These fibular cracks were transversely seen across the bone and in some cases they ran obliquely

on the shaft. In one case the fibular split was of the longitudinal medullary type.

Ten out of fourteen cases of fibular and tibial fracture at the same level were at the junction of the middle and lower thirds of the tibia.

The fibula was fractured below the level of the tibial fracture in seven and six-tenths per cent. of cases.

These important facts show that the *great majority of the tibial lower end fractures are accompanied by fibular injury*. Some of these fibular fractures

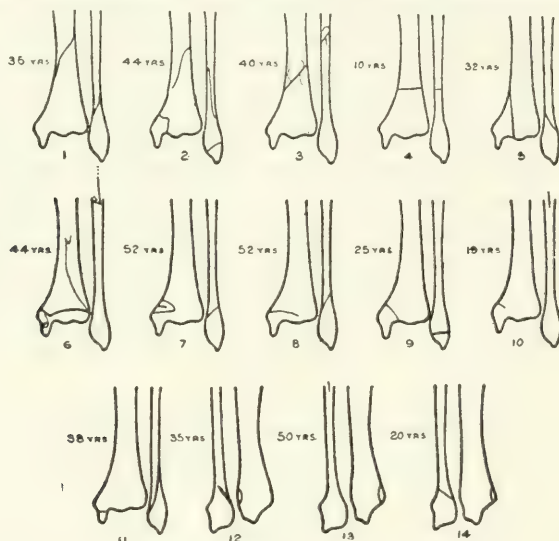


FIG. 6.—Shows fourteen fractures of the tibia and fibula lower thirds. Figures 6, 10 and 13 show the medullary split to run along to the middle third of the fibula. Figures 1 to 11 are antero-posterior and figures 12 to 14 lateral views of the bones. These last three figures, illustrate the marginal type of tibial fracture.

can only be diagnosed with certainty by means of the X-rays, since the medullary splits are of comparative frequency. Doctor Marsh avoids missing these combined injuries by taking in one plate the proximal, and in another the opposite view of the distal end of the bones. The chances of these cases passing unnoticed are then negligible, without increasing the cost of running the radiologic department.

In four cases the tibia and fibula were fractured in more than one place. The distribution of the lines of fracture was very irregular, and, to summarize, the tibia showed altogether eight cracks and the fibula seven in these combined four cases.

If the whole series of the tibial and fibular fractures are analyzed it will be seen that the fracture of both bones is the rule, and the single tibial and fibular fractures the exception. The malleolar region is the commonest seat of the single fractures, particularly in the case of the fibula. The upper half of the tibial lower third fracture is practically always accompanied by fracture of the fibula somewhere above its middle, sometimes at the same level, and very rarely below the tibial line of fracture.

The fibular malleolus was completely broken in fifteen per cent. and incompletely in twelve per cent. of the total leg fractures. The tibial malleolus was completely fractured in three per cent. and incompletely in two per cent. of these fractures (Fig. 6). In two per cent. of these cases a complete fracture of the fibular malleolus was associated with incomplete fracture of the tibia.

These figures demonstrate the *comparative rarity of Pott's and Dupuytren's fractures*, as conceived by these illustrious surgeons. Pott's fracture is, however, commoner than Dupuytren's. The figures generally given relating to the last-named fracture (Malgaigne, Tanton, Potherat . . .), appear to be too high accurately to represent the percentage under modern conditions of civilization.

Relationship between the injury and the kinetoplastic effect on the bone: Slipping on the foot appears to be the commonest type of mechanism and history given by these cases. This usually gives rise to a fracture of the malleoli. The twisting of the leg is particularly responsible for the spiral variety of fracture. The types of malleolar fracture and fracture dislocation due to falling, slipping and twisting the ankle are very numerous.

Marginal fractures of the tibia: There were four cases. *Anterior marginal:* (a) Man, fifty years of age, run over by a motor car; medullary split of the middle third of the fibula, and small wedge broken off from anterior edge of the lower articular end of tibia (Fig. 6, Fig. 13); (b) boy, twenty years old, thrown from horse and fell on heel; complete transverse fracture of external malleolus and anterior marginal fracture of tibia, as above (Fig. 6, Fig. 14). *Posterior marginal:* (c) man, thirty-five years, kicked by a horse; incomplete, oblique fracture of the fibular malleolus and of the posterior lip of the tibial lower articular margin (Fig. 6, Fig. 12); (d) boy, eighteen years of age, fall from bus on to toes, and fracture of posterior lip of tibial lower margin only.

The marginal fractures of the tibia are oftener accompanied by external malleolar fracture as shown above. The tibial split appears to take place somewhere at the centre of the tibial articular border, but is very difficult to locate exactly, on account of indistinctness in the anteroposterior skiagram. A fall on the hyperextended or hyperflexed foot appears to explain these rarer fractures. Earle, in 1828, described the first case ever reported; the patient was "knocked down by two men . . . as he fell his right leg went under him and his ankle struck against the curbstone." The man was fifty-three years of age and the fracture was at the posterior edge of the articular tibial margin. The surgical importance of these fractures is brought out in the works of: Cotton, Sir R. Jones, Malgaigne, Meissner, Quénu, Pels-Leusden, etc., in a masterly fashion. The frequency of these fractures appears to be higher than the last writer has suggested, and the anterior group forms the reason why the foot must be kept well flexed at the ankle in the treatment of these cases, as pointed out by Sir R. Jones.

The so-called *longitudinal or medullary splits* occurred as follows: *Fibula only*: (a) Boy, seventeen years of age, sprained ankle, medullary split of seven centimetres at the lower third of fibula (Fig. 4, Fig. 7); (b) boy, eighteen years of age, fall on foot, medullary split of five centimetres at the junction of the middle and lower thirds of the fibula; (c) man, twenty-seven years of age, cracked the middle of fibula for seven centimetres while stopping a runaway horse and fell on side of leg; (d) man, forty-six years of age, fell on the floor and fractured incompletely the fibular malleolus, accompanied by longitudinal split of middle of same fibula in thirteen centimetres extension. *Tibia and fibula fractures*: (a) Boy, nineteen years of age, fall on leg, incomplete fracture of the tibial malleolus, and five centimetre medullary split at the middle of the fibula (Fig. 6, Fig. 19); (b) man, twenty-nine years of age, fell off a bicycle, oblique fracture at the junction of the middle and lower thirds of tibia, and five centimetre medullary split at the junction of the upper and middle thirds of the fibula; (c) man, forty-four years of age, twisted ankle in a railway accident, comminuted fracture of tibial malleolus and transverse longitudinal split at lower tibial third for seven centimetres, accompanied by comminuted fracture of fibula lower third and longitudinal split for three centimetres at the junction of the middle and lower thirds of the fibula (Fig. 6, Fig. 6). *Tibia only*: (a) Man, fifty years of age, twisted ankle and split of tibial malleolus in a longitudinal direction for four centimetres (Fig. 5). It is difficult to find out the cause of these special fractures. It appears, however, that an indirect type of violence and a probable twist of the limb are responsible for these longitudinal splits. In fact, these cracks can be obtained in a greenstick by means of flexion, rotation and compression produced by the two hands holding the cut ends. Malgaigne described these cracks in the humerus and Cloquet in the femur. I have been able to find evidence of these splits or cracks in those bones, and in several occasions, and due to direct action of bullets. In the case of the forearm and leg bones referred to above, the mechanism of the production of these splits seems to vary, as I have already ventured to point out. I have not been able to find any marked ecchymosis in these cases, which seems to indicate that the fracture is subperiosteal in some cases. The main clinical feature of these cases is the pain and tenderness diffused along the fibular line, and easily elicited by gentle finger tapping.

Single fractures of the middle third of the tibia and fibula appear to be due to *direct injury*—run over, fall against an object, fall of heavy masses on the limb, kicks. In some cases the lines of fracture may be multiple; for instance: Man, thirty-seven years of age, kicked by horse on the leg, fracture of fibula at upper and lower parts of middle third, and comminuted fracture of upper end of lower third of tibia, etc. *The multiplicity of the points of fracture can be due to indirect and direct injury combined*, as shown by the following case: Man, forty-four years of age, twisted foot and fell on the leg; there was a fracture of the upper end of the outer malleolus and

upper part of lower third of fibula, and fracture of the tibial malleolus and outer side of the upper part of the lower tibial third.

A fall on the foot followed by adduction or abduction at the knee appears to be the cause of the *tibial tuberosity fracture*. There were two single cases of outer tuberosity fracture in this series. Both patients were forty-one years old.

The tibial tubercle was detached in two cases. Both were eighteen years of age. In one there was separation of the lower vertical part of the tubercle, in the other there was a wide separation of the vertical part of the tubercle and beginning of the horizontal plate of the epiphysis. The latter was due to a fall on the foot while playing foot-ball, and a likely type of accident which might have produced a fracture of the patella in an older case.

The cases of *fracture of both tibia and fibula* are explained by the intensity of the injury, mechanism of the trauma, and fragility of the bones. It is not possible to systematize all these cases by means of the nature of the trauma. *The spiral type of fractures* of the leg appear to be rather common and seem to represent the rotation element of the trauma. If the rotation is accompanied by compression, as I have ventured to suggest, the bone will break in a longitudinal direction. This was exemplified by the medullary splits as shown above.

An inversion or eversion of the foot appears to explain the malleolar injuries and their wonderful varieties. The foot, as Sir Robert Jones has said, may be dislocated out and the fibular malleolus may not be broken. The injury then may be only localized either at the tibial malleolar tip, stretching or rupture of the internal ligament of the ankle-joint, or even evidence of the inner malleolar contusion may be wanting.

The so-called *epiphysial and juxta-epiphysial strain* is not an uncommon occurrence at the ankle. The X-ray examination may then show no evidence of injury and yet clinically the case resembles a malleolar fracture. There may be swelling and a slight ecchymotic tint at the malleolar and upper calcaneal regions. The pain elicited by means of gentle finger pressure, appears to be more diffuse, extends in a wider area, has not a definite localization to the malleolar ends, and seems to shoot indefinitely upwards towards the knee should the patient attempt to move the limb. At first the functional disability is as notable as in a real fracture and the case may come under the title of local shock. The differential diagnosis, however, of some malleolar fractures (without talar luxation), and the so-called sprained ankle or contused leg, forms still in cases where radiography is not obtainable, an interesting field for observation and reasoning, so well shown in the classic works of Pott, Dupuytren, Cooper and Malgaigne.

In one case of a man thirty-six years of age who fell from a height, there was a fracture of the fibular malleolar tip on the left, and a fracture at the same level of the fibular and tibial lower thirds of the right leg. There was not in this series any case of fracture of the external angle of the tibia.

CONCLUSIONS

1. Back-fire is one of the commonest causes of forearm fracture (thirty-six per cent.) and slipping and twisting the ankle the commonest mechanism of leg fracture in these series.

2. Fracture of the radius alone is the commonest in the forearm (seventy per cent.) and fractures of both tibia and fibula the commonest in the leg (forty-four per cent.).

3. The radius was fractured in eighty-four per cent. of cases of forearm single and double fractures, and the fibula was fractured in seventy-nine per cent. of cases of leg single and double fractures.

4. The lower third of the radius is the most fragile part of the bone and was fractured in ninety-one per cent. of single radial fractures, and the lower third of the fibula is the weakest point of the bone and was fractured in eighty-eight per cent. of single fibular fractures.

5. The upper third of the ulna is the commonest seat of single ulnar fractures (sixty-six per cent.), and the lower third of the tibia the commonest place of single tibial fractures (seventy-one per cent.).

6. The lower third of the radius and ulna is the commonest seat of double forearm fractures (seventy-two per cent.), and the lower tibial third the commonest level of the leg double fractures (eighty-eight per cent.).

7. The lower third, the lower half of the upper third, and the middle third of the fibula is the order of frequency of this bone fractures when accompanied by tibial fracture.

8. The ulna is usually fractured below the radial level of fracture (forty-three per cent.), and the fibula above the tibial (sixty-four per cent.).

9. The classic fractures of Colles, Pott, and Dupuytren, as conceived by these authorities, are comparatively rare.

10. Epiphysial strain, widening of the epiphysial line and the epiphysial fractures are commoner at the wrist.

11. The marginal fractures of the radius (Barton, Letenneur) are rarer than the marginal tibial fractures.

12. Longitudinal or medullary splits are commonest in the fibula.

13. Chauffeur's fracture may occur at the upper end as well as at the lower end of both radius and ulna.

14. The commonest direction of the fibular fractures is from before backwards and upwards and usually incomplete, and only seen in the lateral skiagram.

15. Fractures of the tibial tubercle appear to occur in a growing bone, and fractures of the tibial tuberosity in an adult bone.

16. Fractures of the upper half of the ulna, radius, tibia and fibula diaphysis are usually due to direct trauma.

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DISLOCATION OF THE PISIFORM

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CASE REPORT.—On March 31, 1921, W. G., a school boy eleven years old, came to the Mount Sinai Hospital Dispensary stating that the previous day, while playing, he had fallen and struck his left hand. His exact position at the time of the fall he did not remember. After the fall he had moderate pain in the left wrist but received no treatment. During the night the wrist became swollen and more painful.

When examined he seemed to have a fracture of the lower end of the radius with little displacement, the swelling preventing a more accurate diagnosis. An anterior padded splint was applied and an X-ray examination requested.

As shown by the print, there was a backward displacement of the lower epiphysis of the radius and a dislocation forward and somewhat upward of the pisiform. With the X-ray diagnosis in mind, reëxamination showed the pisiform at a higher level than normal and distinctly movable. It could be pushed up or down through a distance of half an inch; lateral mobility was less marked. Without anæsthesia an attempt was made to reduce the epiphysis. In order to overcome the displacement of the pisiform a small gauze pad was strapped with adhesive plaster over this bone pulling distally, and the wrist put up in flexion.

A second X-ray examination showed the epiphysis only partially reduced and the pisiform seemingly in place; but the angle at which the exposure was made was not the same as in the original, so of this fact we could not be certain. Ten days later passive motion was begun. At this time the pisiform though still more movable than normal was distinctly less so than on the previous examination. About the fifteenth day all function was returning rapidly. The patient was referred for another X-ray examination but failed to report and did not again appear at the dispensary.

In 1901 Eigenbrodt¹ collected five cases of dislocation of the pisiform. I have been able to find one additional case previous to 1901 and three instances since that time. Of this total of nine cases the report by Bieberbach² was not available. The five instances mentioned by Eigenbrodt antedate the use of the Röntgen ray.

Erichsen³ and Ferguson⁴ give no details other than that the injury was caused by muscular violence. Barois'⁵ patient was a soldier who had had the lesion for many years; the pisiform was freely movable, otherwise he suffered no inconvenience. The cause in the case reported by Gras⁶ was muscular exertion applied in a position of extension and adduction of the wrist. The pisiform was reduced and held by a bandage. The patient



FIG. 1.—Separation of lower epiphysis of radius, and dislocation of pisiform bone.

removed the bandage after three days but the bone remained in place. Van der Donck's ⁷ patient fell on the dorsum of the hand with the wrist in flexion. The X-ray plate showed the pisiform between the radius, semilunar and cuneiform, lying in the joint. The bone was excised with marked improvement of the disability. In Cotton's ⁸ patient the cause was direct violence. Several weeks of fixation did not improve the condition and she finally was lost sight of. Ozenne ⁹ reported two cases. The first in a young girl who dislocated her pisiform on attempting to lift a package which she had just put down. The displacement bone could be felt beneath the styloid of the ulna, and there was a depression at the normal site of the pisiform; no X-ray examination was made. The hand was immobilized for two weeks but the bone remained dislocated. Six months later function, except adduction of the hand, was good. The second patient was seen ten years after his injury, which in this instance was also produced by lifting a heavy object.

The cause of dislocation of the pisiform may be either a direct blow or muscular violence. In the instant case it would be impossible to state which was the causative factor. In spite of the relatively exposed position of the bone, the fact that it gives somewhat, coupled with the fact that its capsule is strongly reinforced by extensions from the internal lateral and anterior annular ligaments as well as from the flexor carpi ulnaris, prevents more frequent injuries to it. The disability resulting from the dislocation is slight. If it were greater it would be a simple procedure to suture the pisiform in place.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held October 3, 1921

The President, GEORGE G. ROSS, in the Chair

GAS GANGRENE

DR. FRED L. HARTMANN reported the following case of gas gangrene because of its rarity in civil life:

The man, an adult male, was admitted to the service of Doctor Ross in the Lankenau Hospital, September 5, 1920, on account of an obscure abdominal condition. Upon opening the abdomen, an abscess posterior to the cæcum was revealed. The postoperative course was much disturbed by persistent hiccough. On the seventh day the urinary output had dropped to 700 c.c. For the purpose of stimulating the kidney action, a hypodermoclysis in the thighs of 1000 c.c. normal saline solution was performed. The usual aseptic precautions were observed.

Thirteen hours later the man began to complain of vague pains in the right leg and thigh. These gradually grew worse until after twenty-three hours, a small area about two inches in diameter of emphysematous crepitation was felt at the site of the hypodermoclysis needle puncture of the right thigh. Two hours later the pain had become much more severe, and the examination revealed that the region had become emphysematous from a little above Poupart's ligament down to the ankle. The limb was pale in color and cold with purplish mottling on the dependent portions. The thigh was drum-like but not tender to pressure. No emphysema of the muscles of the lower leg, the gas being under the skin. Temperature, 101.3°; pulse, 110; respiration, 32.

Multiple small incisions were made in the thigh. Gas of a pungent odor escaped. There was no bleeding. Incisions were continued until the entire thigh had been laid open by multiple incisions extending down to the bone. Skin incisions were made in the lower leg. No bleeding was encountered. The blood-vessels were collapsed. The muscles were pale and spongy. The wounds were flushed with hydrogen peroxide and wet dressings of potassium permanganate were applied. The patient was relieved by this treatment but rapidly grew weaker and died two hours after the thigh was laid open. His mind remained clear until the end. At no time did he have convulsions.

After death the right leg on both skin and muscle surfaces was deep purple in color, giving out a pungent foul odor of rotting fish. Examination of cultures two hours after they had been made revealed glucose agar broken up by gas bubbles. No gross growth visible.

HIGH LIGATION OF THE CYSTIC DUCT IN CHOLECYSTECTOMY

The speaker said that it is of importance for surgeons to know that the bacillus of Welch in its most virulent form is not confined to the peculiar soil of Flanders and France, but is present in the vicinity of Philadelphia. He was cognizant of three cases of traumatic gas gangrene in Philadelphia within the past two years.

The source of infection in this patient may be a matter of discussion. The first and most logical one is that the organism was carried to the muscles by the hypodermoclysis needle. On the other hand in this patient there was present an old omental abscess communicating with a perforated appendix. It is a well-known fact that human fæces harbor the bacillus of Welch. Is it not possible that during the post-operative period, especially when the gauze drain was removed, opening up avenues of absorption, the organism already present in the abscess cavity may have gained access to the blood and have been carried by the blood stream to the muscle at the site of the saline injection, where there existed a focus of devitalized tissue?

HIGH LIGATION OF THE CYSTIC DUCT IN CHOLECYSTECTOMY

DOCTORS HARTMAN, SMYTH and WOOD presented a paper with the above title recording the observations made in the Laboratory of Surgical Research of the University of Pennsylvania. For this paper see page 203.

DR. MURAT WILLIS, of Richmond, Va., called attention to the experimental work of Doctors Judd and Mann, where they found dilatation of the extra-hepatic ducts following removal of the gall-bladder. They concluded that this dilatation was purely mechanical, but among their experiments they reported one in which the muscle of Oddi was cut but still there was dilatation of the extra-hepatic ducts. He agreed with the essayist that in all likelihood this dilatation is a physiological or compensatory dilatation. From clinical observation he felt satisfied that any pressure sufficiently great to produce dilatation of the extra-hepatic ducts would be sufficient to produce jaundice. Nobody reports jaundice following cholecystectomy.

DR. J. E. SWEET, Philadelphia, said that his work upon the function of the gall-bladder has led to the conclusion that its function is perhaps more simple than had been thought.

The lymphatics of the gall-bladder are very highly developed. If a suitable solution is placed within the gall-bladder, and the lymph coming from the gall-bladder is collected, the presence of the injected fluid can be demonstrated in the lymph in a very few seconds. Therefore they are coming to the conclusion that the function of the gall-bladder is simply to store the bile which is secreted between the periods of active digestion, or, possibly, not so much to store it, since this implies future use, as to deviate it from the intestine during these periods; and since the capacity of the organ is so small, relative to the total amount of bile secreted during this time, the effectiveness of the process is increased by a process of concentration, or inspissation, accomplished by handing back to the system the fluid part of the bile through the lymphatics.

As to the question of the mechanism by which the gall-bladder empties itself, they had been unable to reach a definite conclusion. Surgeons talk about the contractions of the gall-bladder. But these movements refer to the demonstration of the waves of contraction which are due to the contraction of the smooth muscle, waves common to all smooth muscle, and which are too trivial to play any part in the emptying of the organ. They are inclined to the belief that the only mechanism which can empty the gall-bladder is the general intra-abdominal pressure, supplemented, possibly, by the filling of the stomach.

DR. NICHOLAS M. ALTER, of Pittsburgh, agreed with Doctor Sweet as to the importance of the gall-bladder, when it has normal function. The question arises, however, how the gall-bladder will perform its function under pathological conditions, when mostly bile-stained mucus is contained in it and its wall is inflamed. The biliary ducts may also undergo considerable changes. Whatever the function of the normal gall-bladder may be, it cannot be a contra-indication for the surgical treatment of a diseased gall-bladder.

CARCINOMATOUS PAPILLOMA OF THE RENAL PELVIS

DOCTORS LANDON and ALTER read a paper with the above title.

DR. B. A. THOMAS remarked as to terminology which seems to be somewhat confusing, so far as papilloma and carcinoma of the urinary tract is concerned.

Carcinoma of the kidney begins either in the parenchyma or in the pelvis. As he interpreted this presentation the case is one of a carcinomatous degeneration of papillomata of the kidney. Obviously when a papilloma undergoes carcinomatous change, it ceases to be any longer a papilloma. It is then a carcinoma—a papillary carcinoma, if you please. It seems to be going a little bit astray in the pathology of tumors of the kidney to speak of a carcinomatous papilloma. The classification of these tumors, when of the bladder, is a matter of considerable moment, for upon their correct identification treatment depends; if papilloma, fulguration, cystoscopically, invariably; if carcinoma cystoscopic fulguration never. In the urological mind this question has been threshed out and today urologists are in perfect accord and understanding on the matter. With others the question still seems difficult and chaotic. This kidney tumor is certainly an unusual one. Even a papilloma of the kidney is a very rare condition. He believed there was only one case found in some ninety-four cases of kidney tumor covering a period of ten years at the Massachusetts General Hospital, and Charles H. Mayo found one case in over seven hundred cases of kidney tumor. When it comes to a malignant or carcinomatous degeneration of a papilloma, certainly Doctors Landon and Alter have presented a very rare specimen.

There is no question but that the diagnosis in these cases is difficult. Hemorrhage is not as important a factor as has been commonly believed. It certainly does not occur in more than fifty per cent. of the cases as a primary



FIG. 1.—Experimental fracture of lower end of tibia extending into ankle joint.

CRANIAL DEFECT

symptom; tumor in not more than thirty per cent., and pain in less than ten per cent. Too great reliance cannot be placed upon this clinical sign as a guide to diagnosis.

DOUBLE FRACTURE OF THE TIBIA INVOLVING THE ANKLE-JOINT

DR. A. P. C. ASHHURST referred to a skiagraph which had been shown by Doctor McKnight at the May meeting, which had been reported as a "double fracture of the tibia," but of which only the antero-posterior view had been presented. Doctor Ashhurst at that time had ventured to disagree with the diagnosis, and had suggested that very similar appearances would be presented by a skiagraph (antero-posterior view) of a fracture splitting off a large wedge from the postero-lateral surface of the lower articular surface of the tibia. Such a fracture had been produced experimentally by Doctor Ashhurst, and the skiagraphs of the lesion (Fig. 1) made by Doctor Holloway were now presented to the Academy; the antero-posterior view, he thought, was much the same as in Doctor McKnight's case, while the lateral view showed clearly the single fragment which was detached.

CRANIAL DEFECT

DR. J. S. RODMAN reported the following cases:

CASE I.—A. G., woman, age twenty, on April 6, 1917, was kicked in forehead by horse. Sustained a compound comminuted fracture of frontal bone and right eye was destroyed. Comminuted fragments removed at once at hospital. Right eye enucleated April 9th. Remained in the hospital four weeks and in bed at home four weeks. A bulging about size of a fist developed on side of injury immediately after fracture. This mass pulsates. Patient states that it is smaller when she is lying down. She was admitted to Dr. J. B. Roberts' service in the Polyclinic Hospital, March 2, 1919, with pulsating meningocele in right supra-orbital region about size of lemon—right eye missing. Sac of meningocele tapped on three occasions and a clear fluid removed.

Operation, March 20, 1919, was: Operated 8.30 A.M.; 25 c.c. clear fluid removed from sac. Transverse incision. Opening found in skull—long diameter horizontal about one inch below surface, about three inches in length and one inch wide. Piece of fat and occipito-frontalis fascia made into free graft and stitched into opening with fascial side to brain. Fine silk used as suture material. Graft removed from supra-orbital region. Remains of sac stitched close over graft; redundant scar and skin removed. Only normal skin saved.

Patient seemed markedly improved following operation and remained so for about six months. Pulsation returned in meningocele, however, and general condition gradually grew worse. Status epilepticus suddenly developed March 19, 1921. Epileptiform convulsions began about 3 A.M. of one morning and ended at noon of same day. No convulsions since then.

April 4, 1921, was operated upon for relief of the cranial defect. Traumatic supra-orbital and frontal—right side. About size of hen's egg. Closure—first stage plastic—skin. Removing an elliptical por-

tion of skin about three inches long—one and a half inches in width. Skin edges mobilized and brought together over defect. (Black silk.)

CASE II.—Woman, age twenty-three years, was admitted to the Presbyterian Hospital, February 9, 1921. She complained of convulsions starting in left leg or left hand and with a slight drawing up of the left corner of the mouth. These convulsions become progressively worse, lasting thirty seconds to one minute, and ending quite abruptly.

These attacks started about four years ago. At that time there was only a slight twitching of the left side of the face. For the past four or five days she has had Jacksonian type of convulsion as described above. She seems to know when the convulsion is coming because she indicates this to the nurse; also seems to be conscious during the attack. Pupils equal but contracted and seem to be fixed (due to morphia?), not contracting to light or accommodation. Ocular movements normal in all directions.

Voluntary movements of facial muscles on right side are normal; on left side the angle of the mouth cannot be drawn up as well as the right, but it is not completely paralyzed. Masseter muscles contract normally. Muscular power of upper and lower limbs is equal and normal. Biceps and triceps reflexes also knee jerks are equal and distinctly exaggerated. There is no ankle clonus and plantar reflex is normal on each side. Sensation for pin point seems to be normal everywhere.

During examination patient had two attacks in which facial muscles of left side *only* were involved. There was at first tonic contraction and then clonic convulsion, chiefly of lower facial muscles, but the orbicularis and frontalis were also involved. The tongue was drawn to left lower jaw; was moved clonically. Platysma and sternocleidomastoid stood out prominently on left side, but none of muscles of shoulder or upper limb were affected. Patient states, however, that attack is ushered in with a sensation over left thigh.

During these attacks just described it is positive that upper and lower limbs were *not* involved. After the attack ceased, there was no twitching of facial muscles. No loss of consciousness during the attack.

Provisional neurological opinion probably a lesion in Rolandic region or right side in lower portion, involving chiefly the face area.

Report of eye examination (Doctor Radcliffe): Right and left pupils dilate regularly. Media clear. Disc outlines distinct. No pathological changes in eye grounds with exception that there is a slight fullness of the optic disc. Wassermann negative. States that facial contractions do not come as often as yesterday. Attacks come less frequently, but seem to last longer. States that since yesterday "aura" began in left hand. Before this aura seemed to begin in left foot. More or less constant, moderately severe headache and vertigo. Examination shows distinct weakness of left face, chiefly of lower muscles—upper portion seems almost normal. The left upper limb does not seem distinctly weaker than the right, but movements and grip of left hand are suggestive of beginning impairment of function—but it is very indefinite. Patient yawns frequently. Sensation of fifth nerve distribution is normal. Complaints of pain in teeth of left side.

DOCTOR CADWALADER, in consultation, recommended operation on right side of skull for lesion probably situated in face area of motor cortex. It is not certain that lesion is a tumor.

February 17th: Operation by Doctor Rodman. Ether anæsthesia. Patient in sitting posture. Incision semicircular in temperoparietal region. Osteoplastic flap laid back. Dura exposed; apparently normal except for perhaps a slight bulging over motor area. Dura incised and flap laid back. The brain substance protruded through the incision a little further than normal. No tumor or other lesion demonstrable. Palpation revealed no evidence of any definite mass under the bulging area. An exploratory puncture was made at this site but no fluid obtained. The dura, pericranium and skin were sutured in three separate layers. Patient required a stimulation for about twelve hours after operation. After a stormy period of twenty-four hours convalescence uneventful. Symptom free since.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

Stated Meeting Held October 26, 1921

DR. JOHN A. HARTWELL, President, in the Chair

CYST OF THE POPLITEAL SPACE

DR. JAMES N. WORCESTER presented a man twenty-eight years of age, who in May, 1919, first noticed a small swelling in the right popliteal space which was not accompanied by pain and not preceded by any trauma. This swelling gradually increased in size until in January, 1920, it had reached the size of a hen's egg and markedly interfered with walking; in damp weather there was slight pain and swelling.

In May, 1920, patient was operated on in the Marine Hospital, Staten Island. The details of the operation are unattainable, but the operating surgeon told him that it was a non-malignant cyst and incidentally added that it was a very queer condition.

A recurrence of the swelling was noticed within a month of the time of operation and increase in size was gradual. The only other point of interest in the history is that he has been operated on for fistula in ano and is supposed to have had an inactive pulmonary tuberculosis.

May 1, 1921, he entered the surgical service of the Public Health Service Hospital at Polyclinic Hospital. He then presented in the right popliteal space an elastic mass about the size of a lemon, over which lay a four-inch scar. The mass is not tender; extension in knee is normal; flexion is limited to one-half; there is no fluid in knee-joint.

X-ray of the joint was negative. Pressure over mass does not cause any diminution in size.

Operation was done on May 17, 1921. In the popliteal space just beneath the skin was found a thin-walled sac about the size of a lemon; this extended down to the posterior surface of the capsule of the knee-joint, but was not in any way connected with it or with any of the bursæ. In dissecting this free from the scar tissue of the previous operation the sac was opened and a semi-gelatinous clear fluid escaped. The main sac was easily freed, but running from its upper angle was found a strand of dense tissue about three-fourths of an inch in diameter. On cutting into this it was found to have a definite lumen connected with the main cyst. This strand ran in the substance of the semi-membranosus muscle and was dissected from this and followed up to where it disappeared beneath the glutei muscles and running to the neighborhood of the hip-joint where its connection with the hip-joint was impossible to determine. Proceeding from the lower portion of the main cyst was a second similar prolongation which ran into the deep muscles of the calf between the two origins of the gastrocnemius muscle.

PARTIAL GASTRECTOMY FOR PENETRATING ULCERS

By a ten-inch incision over the popliteal space the cyst was freed by dissection, as was also its continuation upwards; this continuation was cut off at the highest possible point. A similar procedure with the lower prolongation and the muscles brought together with plain gut and skin with silkworm and silk. The wound healed by primary union. To date there has been no recurrence. The pathologist's report was simple cyst lined by fibrous connective tissue. The contents of the cyst looked like the gelatinous contents of a bursa.

PARTIAL GASTRECTOMY FOR PENETRATING ULCERS

DR. RICHARD LEWISOHN presented four patients upon whom he had performed a partial gastrectomy for penetrating ulcers of the lesser curvature and the posterior wall of the stomach. The patients were all males, twenty-three, twenty-eight, thirty-eight, and fifty-five years old, respectively. Three patients had been suffering from gastric distress for one year or less, whereas one patient gave a ten-year history. He had had an appendectomy performed upon him at another hospital eight years previously. This operation, however, had failed to give any relief of his symptoms. The complaints of these four patients were almost identical: typical hunger pains about one hour after meals, with marked intermission of their symptoms.

The X-ray examination showed in three patients the typical picture of a penetrating ulcer of the lesser curvature; whereas the last patient, operated upon three weeks ago, had no defect. He had, however, a slight residue in his stomach after six hours. This residue in association with a very typical ulcer history was sufficient indication for operative interference.

The operation consisted in partial gastrectomy. After ligation of the vessels, the stomach was divided proximally to the ulcer on one side and just distally from the pylorus on the other side. In one case the ulcer occupied a large portion of the posterior wall, and was so densely adherent to the pancreas that the base of the ulcer was left attached to the pancreas. This case, technically the most difficult of the lower operations, had very large glands along the lesser curvature and in the transverse mesocolon, which aroused a suspicion of the malignant nature of the ulcer. If it were a carcinoma of the stomach, this case would have been inoperable on account of extensive glandular involvement. However, it was decided to give the patient the benefit of the doubt. Microscopical examination of this, as well as of the other three ulcers, showed benign ulcer. The glands in the case just mentioned showed inflammation, but no malignancy. This patient is feeling very well now, one and a half years after the operation.

The gastro-intestinal continuity can be reestablished by either the Polya-Balfour method or by gastro-enterostomy. Button gastro-enterostomy was used in these four cases. Before closing the gastric end, one-half of the button is dropped into the remnant of the stomach. After stomach and duodenum have been closed in layers, and after the other part of the button has been inserted into the jejunum, a very small stab is made into the posterior wall of the stomach. The gastric half of the button is then pushed

through this opening and stomach and jejunum are thus united. This method makes anastomosis a very easy procedure, even in extensive resections. The abdomen was closed without drainage.

All the patients made uneventful recoveries. Three patients left the hospital two weeks after the operation; one stayed seventeen days. The buttons passed without causing any trouble in three patients. The fourth patient (operation three weeks ago) has not passed the button as yet.

Doctor Lewisohn stated that simple gastro-enterostomy fails to cure penetrating ulcer at or near the lesser curvature. He had seen two cases, where gastro-enterostomy had been performed previously by other surgeons. Re-operation and excision of the ulcers cured these cases. Simple excision and sleeve resection are apt to cause hour-glass formation. Local excision with knife or cautery, followed by gastro-enterostomy, gave better results. He had performed this operation on six patients. However, the final results are far better following partial gastrectomy. For this reason the more radical procedure was applied in these four cases. These patients are perfectly well, without any discomfort, though in two of them more than two-thirds of the stomach was removed at operation.

DR. JOHN A. HARTWELL corroborated Doctor Lewisohn's statement that these cases did better than those in which mere excision of the ulcer was done, his experience corresponding to the results obtained at Bellevue where most of the operations had been done by Doctor Woolsey. In general it was found that the cases with this kind of operation were more comfortable and freer from symptoms. But even with this operation these patients should take great care all their lives after operation to avoid a recurrence of symptoms by discretion in diet.

DOCTOR LEWISOHN added that these patients had to keep to a strict diet for a year at least. It was not sufficient merely to excise the ulcer and perform a gastro-enterostomy. On leaving the hospital they were given a printed slip listing what foods to eat, and it had been found that if they kept within these limits for a year or longer the ultimate recovery was complete. But if they fall into bad habits and eat anything they like, the results are not good. The cases shown were all completely free of symptoms.

EXTIRPATION OF ONE (LEFT) ADRENAL GLAND FOR THE CURE OF EPILEPSY

DR. HERMANN FISCHER, in presenting a patient, said that up to the present time the efforts of surgeons to cure epileptic convulsions have been mainly confined to operations on the brain and on the skull, with the very few exceptions in which peripheral irritation of old scars or some nasal or other peripheral pathologic condition was held responsible for the production of convulsions. Recently Heinrich Fischer, of Giessen, has advanced a very interesting and new theory which he has substantiated by animal experiments.

He found that *by reduction of adrenal substance in the animal body, the tendency to convulsions can be reduced.* His experimental work on rabbits

showed that in these animals no more convulsions by amyl nitrite could be produced after the adrenals had been removed. In the opinion of Fischer the animal nervous system played a subordinate rôle in the production of convulsions. It is the vegetative nervous system and the organs of internal secretion to which our attention must be directed in the endeavor to solve this vexed question. By reducing the substance of adrenal tissue muscular tonus is reduced and, in consequence of this, other stimuli causing muscular irritability become less effective. This theory of Fischer has been taken up by Brüning and put to a practical test in fourteen cases of severe epileptic convulsions, by removing a part or a whole of one adrenal gland.

He reports no mortality. Three cases are still under treatment. Of the eleven cases, five are cured, respectively, very much improved. In five cases no material improvement. In one case attacks are less in intensity and duration but occur more frequently. No result in three cases (age—thirty-eight, fifty-two, forty-five) who had their attacks for a long time. Characteristic for all cases is, that the attacks cease immediately after the operation. If new attacks occur they can usually be suppressed by administration of very small doses of sedobrol or luminal 0.05 t.i.d., whereas all these medicaments had no influence at all before the operation.

In January, 1921, the following case of epilepsy of long standing came under the observation of the reporter, referred by Dr. N. Ransohoff.

The patient was a man twenty-five years old, who had been suffering from epileptic attacks for sixteen years. His family history is negative as far as nervous diseases are concerned, with the exception of an uncle of his mother who died from "softening of the brain." The beginning of his disease dates back to early childhood when he was subject to frequent attacks of convulsions. When seven years old he was hit by a trolley-car and pushed several feet; he did not sustain any injuries, but was very much terrified by the accident. After this psychic trauma he began to have epileptic attacks more frequently and more severe. Slowly the disease has progressed in spite of long treatment, medical as well as surgical. He now has ten to fifteen attacks every night, his psychical condition is deplorable. He had scarlet fever, whooping cough, measles and mumps. At seven years of age he had chorea which lasted one year.

Up to 1914 his attacks were of the type of epileptiform equivalents and petit mal, after that he had typical attacks of grand mal. In 1910 circumcision and in 1915 a subtemporal decompression on both sides was done without giving any relief. In 1918, following a series of attacks, patient hallucinated for several days. Attacks are more frequent at night. Complaints of frontal headaches and occasional attacks of temporary blindness after attacks.

He was a well-built young man of twenty-five years of age, slow in coördination of speech and movements, rather expressionless face. Upon questions he reacts very slowly, has difficulty in speaking as he forgets words and is unable to finish a sentence. He is listless towards

his surroundings and is aroused with difficulty. His mental condition is one bordering on idiocy. His head was well developed and presented scars of two operations for subtemporal decompression. The pupils react equally to light and accommodation, vessels normal, optic muscles normal, optic disk normal, a little pale on temporal side.

The report as to endocrine condition, made by Dr. A. S. Blumgarten, was as follows: The patient is a rather dull, lethargic blonde young man, slow and deliberate in his movements and in speech. The skin is markedly pigmented, especially around the lower abdomen, acne on back. There is a moderate growth of hair over lower abdomen, legs, thighs and buttocks. There is no Sergeant's line. There is a marked generalized adiposity. The head shows evidence of previous trephining operations. The forehead is prominent and broad. The lobes of the ears are attached to the side. The nose is normal and not unusually broad. The lips are thick and prominent. The teeth are in excellent condition; there is no increased interdental spacing, but the lower set come directly in apposition with the upper. The neck is short and stocky, the thyroid is not enlarged. Chest is broad, the costal angle is wide, the breasts are well developed. The extremities are normal, the hands are rather delicate, the fingers are long and pointed. No tremor, no cyanosis.

Sugar tolerance slightly diminished; blood chemistry slightly low sugar; pilocarpine test negative; Goetsch test moderately positive; blood pressure, systolic, 85; diastolic, 55.

Conclusion: The patient is a pituitro-adrenal type.

As all attempts of a cure had been futile in this case and as the condition of the patient was becoming worse and more deplorable every day, it was deemed justified to give this new operation a trial.

Operation.—*Extirpation of left adrenal gland*, February 12, 1921. Typical lumbar incision (Bergmann-Israel) as in operation for nephrectomy with resection of twelfth rib. After exposure of the fat capsule of the kidney, the kidney, together with its perirenal fat capsule, was dislocated downward by introducing one hand into the wound and by tearing the loose areolar tissue between the diaphragm and the upper pole of the kidney capsule. By this manœuvre the kidney could easily be pushed down far enough to expose the upper pole of the fat capsule. The perirenal fat capsule was now carefully separated with blunt forceps until the flat, greenish-gray adrenal gland was seen resting on the top of the kidney. The organ was now carefully removed from the upper pole of the kidney by blunt dissection, a small arterial branch coming down from the diaphragm was torn, the main artery and two small veins coming from the renal artery and vein, respectively, had to be tied. One has to exercise some care in dissecting the median aspect of the gland, as it lies in close contact with the renal vein.

The organ was removed in toto without tearing. There was no bleeding of any account. A cigarette drain was put in the bed of the

TUBERCULOUS ABSCESS OF THE CHEST WALL

removed organ and led out through the wound; wound closed down to drain.

The operation lasted one hour and five minutes.

The pulse after operation went up to 140, but soon came down to 90-100.

The blood-pressure which was 85/55 before operation jumped up to 110/65.

On the third day post-operative blood-pressure was 115/65. Patient in good condition, mentally much brighter. Wound was draining rather profusely. His convalescence was smooth.

Two weeks after operation he felt very well, was much brighter and in the last days more alert, took an interest in his surroundings, read the paper and even wrote a postal card to his relatives which he had not done for years. Has had no convulsion since operation.

(On admission to the hospital he had a very severe convulsion, on January 31st and February 2nd; another on February 5th, then one slight convulsion on February 11th. During the night of February 12th, just before operation, three severe convulsions.)

On the nineteenth day after the operation he had five convulsions during the night, each convulsion lasting one-half to one minute. During the succeeding three weeks there were daily convulsions varying in number from one to seven. After March 26th there was a period of two weeks during which there were no convulsions, so that on April 10th, he was discharged from the hospital. Ten days later there were several slight convulsions described as very light as compared to those previous to the operation. Then followed a period of three weeks of freedom from convulsions, after which for a period of five months there were at varying intervals light convulsions. After September 8th there were no convulsions up to October 28th, at which time the history was concluded.

The reporter called attention to the fact that in his opinion, although the patient had not been cured, there has been obtained a distinct improvement. Before the operation he had from ten to fifteen attacks every night—the convulsions being so severe that he had to be held down to prevent him from falling out of bed. The attacks are now less in frequency and intensity and as the records show there have been considerable intervals of complete absence of convulsions.

TUBERCULOUS ABSCESS OF THE CHEST WALL

DR. HUGH AUCHINCLOSS read a paper with the above title.

CORRESPONDENCE

THE USE OF FASCIA LATA TO REPAIR DEFECT OF HEEL

EDITOR ANNALS OF SURGERY:

Sir:

The use of fascia lata for the repair of defects is not at all new, but the result of its use in this case I have to report is at least interesting.

A man, F. W., aged thirty-six, a shoemaker by trade, was referred to me in April, 1918, for osteomyelitis of os calcis, which diagnosis had been confirmed by X-ray.

Three years previous to this time while driving a mowing machine patient was thrown out, and blade severed the tendo achillis. This was sutured and healed by first intention except that patient suffered complete anæsthesia of heel. After his illness he was unable to get employment at his trade (shoemaker), but secured a position on a coal team delivering coal. Eight months later a sore developed on his heel from which sero-purulent material was discharged. Temporary success only was achieved by several attempts to clear up this condition, such as curettement and packing of the os calcis.

In 1918 a further thorough curetting, followed by injections of bismuth paste, finally gave him a clean wound and eventual healing. The resulting scar, which was firmly adherent to the os calcis, left a marked depression in the heel pad. Six months after he resumed work a large, firm callosity filled the previous depression, and within a few days evidence of sepsis was present and a purulent discharge from the original site showed that the condition was not cured.

The dead skin separated with the callosity, leaving a clean scar, the same condition as he had had seven months before. In other words, it was quite apparent that the os calcis was not getting its much needed protection from the pad and a cure must consist of reconstructing the heel pad.

In October, 1920, patient was admitted to Memorial Hospital and plantar surface of os calcis exposed by turning down heel pad with an incision extending from back of heel to outer side of sole. Scar was firmly adherent to os calcis and in detaching it considerable periosteum was denuded.

An incision was then made in the outer side of thigh and a square of fascia lata removed. This fascia was then sewed to make complete covering for the plantar surface of os calcis. Heel pad was sutured back and foot kept at rest for three weeks.

Wound healed by first intention and weight bearing was allowed in six weeks.

Patient resumed work at the end of twelve weeks and now at the end of a year reports perfect function and no recurrence of his former trouble. The heel pad is large and not adherent. In the meantime his anæsthesia has practically disappeared.

CHARLES E. AYERS, M.D.,
Worcester, Mass.

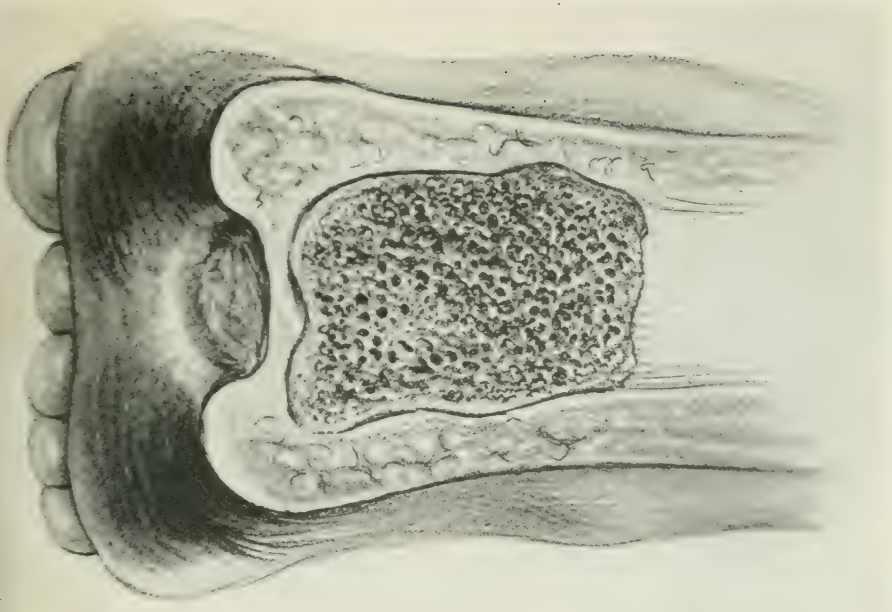


FIG. 1.—Section through os calcis showing scar with loss of heel pad.

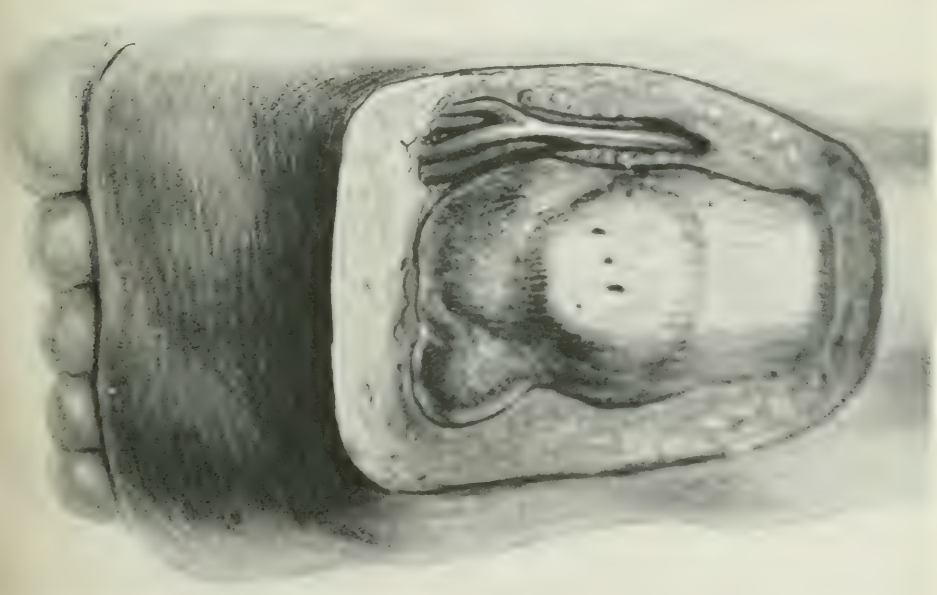


FIG. 2.—Showing normal heel.

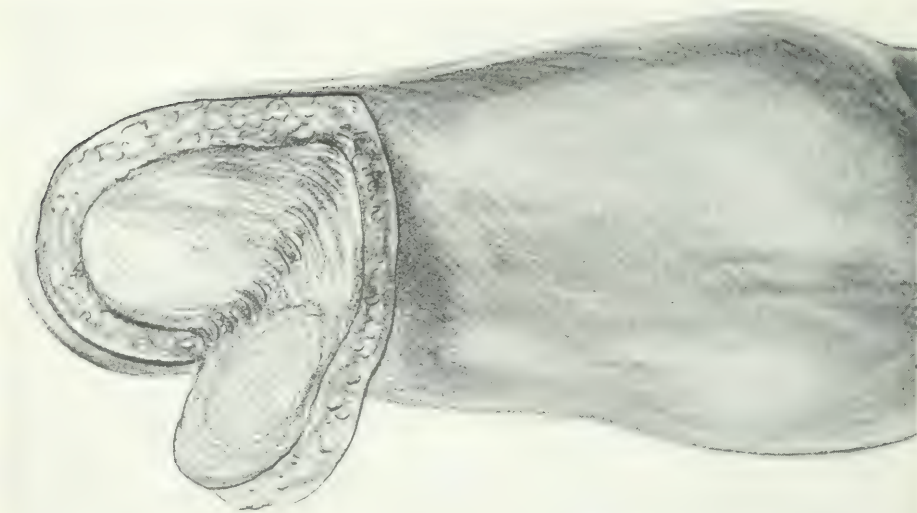


FIG. 3.—Method of exposing the plantar surface of os calcis.

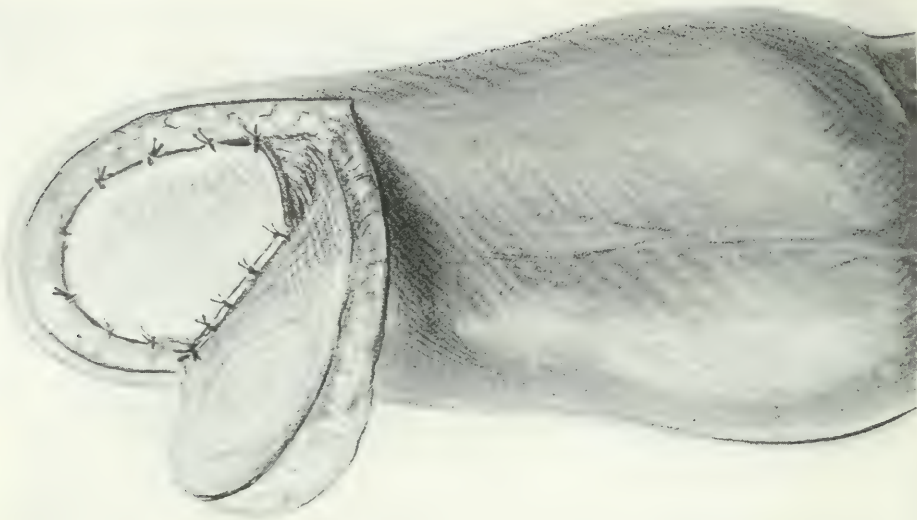


FIG. 4.—Fascia lata sutured in place as protection for os calcis.

GUNSHOT WOUND OF HORSE-SHOE KIDNEY—GUNSHOT WOUND OF EXTERNAL ILIAC ARTERY

EDITOR ANNALS OF SURGERY:

Sir:

I desire to report through the ANNALS OF SURGERY a case of injury to a "horse-shoe" type of kidney, and also one of severed right external iliac artery, both cases terminating in recovery. The rarity of the conditions involved is the reason of this report.

GUNSHOT WOUND OF HORSE-SHOE KIDNEY

The patient, W. M., aged twenty-eight, white, male, American, occupation farmer, was admitted to the Anderson County Hospital, 4.30 A.M., January 21, 1921. About an hour before admission, he had received a gunshot wound. Examination showed the wound of entrance small, round, punctured wound in the lumbar region just to the right of the spine, about the level of the last lumbar vertebra. No wound of exit. He was in a state of shock; blood-pressure 90 over 60. He complained of severe pain in upper right abdomen in region of gall-bladder.

The X-ray showed a bullet in the liver substance anteriorly, about two and a half inches beneath the anterior abdominal wall. Catheterized specimen of urine showed specific gravity 1.020, reaction acid, trace of albumen, no sugar, no casts, many blood-cells. The urine showed blood macroscopically.

The abdomen was opened through right rectus incision. The cavity contained quite a large amount of dark free blood, which was sponged out and intestinal tract explored. No injury to any of the hollow viscera was found. A perforation of the posterior peritoneum over the region of right kidney was exposed. This hole was enlarged and the kidney explored. A large ragged wound which severed the cortex of the kidney at the level of the pelvis was found. The lower pole of the right kidney was fused with lower pole of left kidney by an isthmus of the kidney tissue, about one and one-quarter inches in width, about one inch in thickness. The left kidney was apparently two-thirds the size of the right. Its pelvis felt normal and we were reasonably sure that we felt the ureter coming off from it. The right kidney, or rather the right horn, of the "horse-shoe" kidney was then resected at the thinnest portion of the isthmus, and removed. The blood supply of this kidney consisted of several small arteries that flowed in at the pelvis, instead of a normal artery. The lower pole of the then remaining left kidney was sutured, and the rent in the posterior peritoneum closed. A perforation was found in the under surface of the liver near its posterior border. The channel of the wound ranged upward and forward towards the external surface of the liver. The wound was explored with the index finger for the full length of the finger, but the bullet was not felt nor was the bottom of the wound reached. This liver wound was not bleeding at all freely, and realizing the difficulty we would have in trying to remove a pack in this region, we left it abso-

lutely alone and closed the abdomen, leaving in a small split rubber tube drain. The right renal region was drained through a stab wound in the posterior lumbar region, by a split rubber tube. Patient was put in a warm bed and given continuous Murphy drip, two per cent. sodium bicarbonate, five per cent. glucose, for two days. He had some reaction on his first day, temperature reached 101°, pulse as high as 130; both came down gradually, and had reached normal by the second day. From thence on his recovery was uneventful. His urinary output first twenty-four hours following operation was 28 ounces. This gradually increased each day until the normal output was reached. He had no jaundice at any time and was discharged on the 17th post-operative day. General condition good, wound healed, primary union. Fluoroscopic examination on the date of discharge showed the bullet just beneath the anterior abdominal wall, over the liver area, at the eighth rib, in the anterior axillary line, probably beneath and in apposition with eighth rib.

In view of this report it is probable that this bullet might have been found at the time of operation by passing hand over upper surface of liver, but patient's condition did not justify any more manipulation than necessary. He was discharged, still carrying the bullet, and was advised against further treatment, unless it began to give trouble. In which event we believe it could be easily removed under local anæsthesia.

PENETRATING WOUND OF ABDOMEN AND SEVERED RIGHT EXTERNAL ILIAC ARTERY

A negress, age twenty-two, was admitted to the Anderson County Hospital, February 26, 1921. Eight hours before admission she had received a gunshot wound in the lower left abdomen. She immediately went into a condition of shock, with air hunger; the right foot felt cold and numb. She reached the hospital at 2 A.M. the following morning, after fifteen miles drive in a Ford over rough roads, with several hot bricks applied to right lower limb in attempt to keep it warm. When admitted she was in a state of extreme shock. Blood-pressure 80 over 44, extremities cold to elbows and knees. Right lower limb insensitive, some slight movement. Small penetrating wound .22 calibre size, one and one-half inches below and one inch to the left of umbilicus. Abdomen very rigid.

No X-ray work done. Patient carried to the operating room, abdomen opened through longitudinal right rectus incision, abdominal cavity found filled with clotted blood and some fecal matter. After removal of the blood clots from the abdominal cavity the hemorrhage was found coming from a perforation of the posterior peritoneum in the right iliac fossa in the region of the iliac vessels. The parietal peritoneum was then stripped from the lateral abdominal wall, and the external iliac vessels exposed. The external iliac artery was found severed by a ragged wound about half-way between its junction with the internal iliac artery and Poupart's ligament. All the surrounding connective tissue was infiltrated with blood. The artery was plugged up with blood clot and was oozing very little. On attempt at dissection of artery, the clot was forced from lumen of vessel, and it began to spurt.

The artery was compressed and held while an assistant dissected it up and ligated both ends. No attempt was made at reconstruction of artery as the patient's condition would not justify that kind of procedure. A small tube drain was placed down between the peritoneum and abdominal wall. The alimentary tract was then explored, and fourteen small perforations in the ileum, and six in the mesentery, were found and sutured. The abdominal cavity was irrigated with five gallons of hot saline and the abdomen was closed with a large rubber drain with gauze in the cul de sac. One thousand c.c. saline were given intravenously. The operation was started under very light ether anæsthesia, which was entirely discontinued before we were half through. She was in a state of profound shock when put back in bed. As soon as she reacted, head of bed was elevated. Was given Murphy drip continuously, two per cent. sodium bicarbonate, five per cent. of glucose, morphine freely, nothing by mouth. The right lower limb from knee down remained cold and no pulsation could be felt. Second day following operation developed blebs had formed over the entire right leg from the knee down, due to burns received before admission. She had a rather stormy time for five days, after which the temperature began to drop to near normal, and the abdominal condition began to improve. After two days of apparent improvement the temperature began to rise. She began to get septic from gangrene that was developing in her leg. Great sloughs of burned tissue had been dissected out from her leg and foot previous to this time. The burn on the anterior portion involved the tibia. On the tenth day she was carried back to the operating room and an amputation done. Under ether an amputation at the middle and lower third of the thigh was done.

She suffered very little shock from the amputation, and her general condition began to improve immediately after. Infection in the stump finally cleared up and on April 1st, after thirty-four days' stay in the hospital, she was discharged with healed stump and healed abdominal wound, and in very good condition.

The only reported case of severance of the external iliac artery with survival of the patient that I have been able to find is the one reported at length by Doctor LaRoque, of Richmond, Va., in the March, 1921, number of the *ANNALS OF SURGERY*. In this patient the artery was severed at a lower point and a tourniquet was applied very soon after the accident. He ligated the artery and vein and patient had a complete recovery, and a perfect function of the limb.

The only explanation that I have to offer for the survival of my patient, with a lapse of eight hours from the time of severance to ligation, is that the small bullet caused such a small perforation in the peritoneum which hindered any free outlet of blood, hence the infiltration of the tissues along the artery, the production of enough pressure on the artery to stop the bleeding. Possibly this patient would have developed enough collateral circulation in her limb to have prevented gangrene, had it not been for the extensive burns caused by the heat applied by her family on the way to the hospital.

S. C. DEAN,
Anderson, S. C.

PARALYSIS FOLLOWING USE OF SEHRT'S TOURNIQUET

EDITOR, ANNALS OF SURGERY:

Sir:

Recently several articles have appeared in the ANNALS OF SURGERY and in other publications advocating the use of the metal tourniquet. In a number of these articles it is claimed that no damage is likely to follow the use of this instrument. I wish to report a case where grave injury was caused to the three main nerve trunks of the arm by its use. A Chinese patient, aged twenty-one years, was attacked by robbers and was severely injured. Among other injuries the tendon of the flexor longus pollicis was divided at the metacarpophalangeal joint. The wounds were of course infected. Patient applied to this clinic for relief six months after his injury. The medium sized Sehrt metal tourniquet was used over a towel around the middle of the arm. This tourniquet was placed above the sterile field. During the operation hæmostasis was not complete and the tourniquet was tightened by an orderly. The dissection was difficult, due to the scar tissue, and the tourniquet was in place nearly one hour. As a result of this the patient showed immediately partial paralysis of the muscles supplied by the radial, ulnar and median nerves, with paresthesia over the distribution of the ulnar and median nerves and complete anæsthesia over the radial distribution. At the present time, five months after operation, sensation and muscular power are normal.

I feel that the serious result following the use of this tourniquet on the arm justifies this report, especially in view of the esthusiastic article commending the instrument which appeared in the ANNALS OF SURGERY in 1920.

ADRIAN S. TAYLOR,
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Peking Union Medical College of China.

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RESECTION OF THE LUNG FOR SUPPURATIVE INFECTIONS WITH A REPORT BASED ON 31 OPERATIVE CASES IN WHICH RESECTION WAS DONE OR INTENDED

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IN the literature of surgery there is little to be found on resection of the lung for what may be called suppurative bronchiectasis. In a recent search there were found less than thirty cases. The majority of surgeons appear to have been content with palliation, and in most instances the patient goes about during his periods of remission merely waiting for the next exacerbation and not able to count on any particular period of uninterrupted usefulness. Occasionally an individual coughs his way through life—never a long one—and manages to exist as a semi-invalid, the copious, foul expectoration which no medicine can control being a handicap difficult to bear. Patients have even threatened suicide if refused the chance for cure by operation though they knew that the danger was great.

It is not a simple matter to decide what to do. To refuse to operate upon a wretched patient, otherwise incurable, merely because the statistics may be unfavorable, seems hardly fair; yet, one of the functions of our profession is the prolongation of life and what we call an operative death is always a calamity. The first important problem, then, is to determine what class of cases is suitable for the radical step of lobe resection. If anything less dangerous promises a cure † or a tolerable existence with the ability to earn a livelihood, lobectomy should be abandoned in its favor. But it must not be forgotten that any operation which glues the diseased lung to the chest wall over a wide area will, in case of failure, prevent subsequent lobectomy. I say this judging by my own experience. Robinson, Sauerbruch and others appear to recommend extirpation of a lobe in several stages even after bronchial fistulæ have formed. The difficulties and dangers of this procedure, however, are probably greater than those of a one- or two-stage typical lobectomy.

I feel that it is time I reported my experience in this field of surgery. My first case of lobectomy bears the date of February 27, 1914. Counting out a year's absence (1918) this leaves six working years with 31 cases.

* Read before the New York Surgical Society, December 14, 1921.

† No method known to me.

In 14 of these, in which a single lobe was removed for disease limited to that lobe, six died, or 42.8 per cent. In 10 cases, in which the disease was not limited to a single lobe and in which more was done than the removal of a single lobe, there were seven deaths, or 70 per cent. In the remaining seven cases lobectomy had been intended but could not be completed, sometimes nothing but an exploration having been made. Five of these patients died although there was no fatality on the table. One seems absolutely well (Case No. 31) one and a half years after thoracotomy and mobilization, and the other (Case No. 12) has a bronchial fistula and is in the hospital.

While the mortality rate seems high, it must be remembered that there are included all cases in which at operation lobectomy was performed or intended, not necessarily even attempted. The cases have been unselected except that they were all supposed to have been unilateral. In all except two of my finished cases the patient, if he survived, may be considered cured; which means that all wounds are healed and that the patient is able to live a normal life, working and exercising as usual, although no one has thus far engaged in occupation involving heavy manual labor. One of these patients (Case No. 21) still has productive cough, but without odor and the presumable cause, nasal pansinusitis, is still present and under treatment. The other (Case No. 3) is working at his occupation, that of secretary, and has been continuously thus employed since he left the hospital. (Reported in *Surgery, Gynecology and Obstetrics*, November, 1919.)

These apparently modest statistics are presented because I believe that I have here enough cases to form the beginning of a working basis in determining the danger of operation in the various forms of lung suppuration which are here represented. It appears to me, then, that in selected cases we may count upon the survival of 50 to 60 per cent. of the patients, nearly all of whom will have been actually restored to health by surgery. And this percentage is by no means discouraging. Compared with those in which palliation, so-called, has been secured and compared with the mortality rate of other surgical diseases of like gravity, and considering the present stage of this newly developed side of thoracic surgery, any percentage of cures over forty may be considered excellent.

As an example of an unsuccessful operation intended for relief I will cite the case of *Mrs. J. P.* After a year of misery following a post-tonsillectomy lung infection, an abscess was drained in two stages, but little relief followed. Four years later she came to me, a frail little woman, with clubbed fingers, foetid breath, with cough and foul sputum, and with a discharging wound in her back from which escaped pus as foul as that which was expectorated. Surely this attempt at palliation had not been worth the effort. Before reaching my present conclusion in regard to resection of these suppurating lungs, I myself have operated upon patients by this attempted drainage. I saw my patients die of hæmoptyses, or of sepsis without relief. I also succeeded in securing

some drainage with limitation of cough by means of bronchial fistula formation, but here also there were exacerbations with cough and fetor. The only patients who appear to be happy, normal beings, are those who have recovered after radical resection.

Indications and Contra-indications.—*First:* Children and young adults are by far the best subjects. After the age of thirty-five the operation becomes extra-hazardous because the resiliency of the patient is impaired. With or without sepsis it is the power of the heart to adapt itself which is perhaps the greatest factor in determining resistance. While this is practically so in all surgery it appears to be more striking in resection of the infected lung. This is of importance in regard to prognosis. It does not mean that we should deny older persons the benefits of surgery in incurable disease, but it does mean that we must frankly make known the added risk when the patient is more than, say, thirty-five. In any event, digitalization should be accomplished in the forty-eight hours preceding operation.

Second: The distribution of the morbid process. For example, a patient with a bilateral suppuration would be considered an unsuitable subject. Cases in which there is dense infiltration close to the mediastinum are extra-hazardous, and while suitable for exploration will probably not come to resection. (See Case No. 31.)

Third: An individual thirty-five years of age or more, who has been previously operated upon with resulting dense adhesions and perhaps fistulæ, would be almost an unwarrantable surgical risk. If palliation can be secured through drainage by bronchial fistula, the time might come, perhaps, for eventual resection; but I have not succeeded in saving one of these patients. (See Case No. 9.)

Fourth: The coexistence of other serious disease, such as cardiac, renal, or grave metabolic disturbances. In a syphilitic, lobectomy should not be performed until the Wassermann examination is negative and has been so for months.

This Wassermann examination must be made in every case in which another exciting cause, such as aspiration of a foreign body, tonsillectomy, etc., cannot be assigned. Or even as a routine in every case. Syphilitic deposits pressing upon one of the branches of the bronchial tree may be the cause of a bronchiectasis which can be relieved by anti-luetic treatment. In one of my patients there were for years the characteristic symptoms of suppurative bronchiectasis confirmed by X-ray; there were lesions in both lungs. Finally an empyema developed from the perforation of one of these bronchiectatic abscesses into the pleura. Following the surgical treatment of the empyema, combined with anti-syphilitic medication, this patient made a complete recovery.

Fifth: Systolic pressure of less than 100, while not a contra-indication for ultimate operation, would make postponement advisable.

When a patient has suffered for more than six months on account of

suppurative bronchiectasis, suppurative pneumonitis, or multiple parenchymatous lung abscess with cough and foul, copious expectoration, with febrile exacerbation and sepsis, it is probable that nothing short of the actual removal of the diseased portion of the lung will restore health. Also, the so-called drainage operations, in any except a few discreet or single abscesses of the lungs, probably parenchymatous, promise little. Palliative measures should be reserved for those absolutely unsuitable for radical surgery, such as persons in advanced age or with bilateral disease. According to Sauerbruch, it is desirable to close the thoracic bronchial fistulæ if the patient has been otherwise well for a long time; but he admits that this is by no means a simple procedure or devoid of danger.

As a rule the patient will not come for radical treatment until he has been ill for many months, or even years, and has become heartily tired of his condition. In my cases the mean duration of the illness before coming to operation has been one year.

Typical lobectomy in acute gangrenous conditions is little known. Perhaps the case of *Gertrude K.* should fall under this head. Here, immediately following tonsillectomy, the patient had what was supposed to be an "ether pneumonia." It proved to be a left lung suppuration. Although this particular patient died from sloughing of a vessel wall, perhaps we shall find that in the lung as in other parts of the body moist gangrene is best treated by ablation. If operable pulmonary suppuration were as common as gangrenous appendicitis, surgeons would learn how to deal with it; and I may say by the same means, extirpation.

Management of the Case.—Before accepting the case for operation, the state of affairs is fully explained to the patient and his family and the operative risk is gone into in detail. They should request me to operate; I do not try to persuade them.

Date of Symptoms.—A superstitious person might find an excuse for his infirmity in the large number of post-tonsillectomy lung infections in which cough and foul expectoration first occurred on the thirteenth day after operation. Rarely have I observed the beginning of the symptoms before the fifth day; still more rarely after the eighteenth day. In from ten to fourteen days in most of these cases the disease has declared itself.

Extent of the Disease.—The size of the lesion is not always indicated by the daily output of sputum. I have seen a quart of foul mucopus issue daily from a middle lobe bronchiectasis without remission for many months, while in other cases an upper or lower lobe had been the seat of extensive suppurative bronchiectasis with only ten to twelve ounces a day, and with remissions during which there was little or no sputum.

Bronchoscopy and X-ray Examination.—Within limits, the more one knows of the location and character of the disease before operating the better. But though I heartily favor bronchoscopy, it need not be employed in every case. After all, the chest is to be opened, and opened widely, and conditions may then become apparent that could not possibly have been predicted. The

really necessary things to know are (1) whether the disease is in the upper or the lower part of the chest; (2) whether it is near the hilum or near the periphery; and (3) whether there is perhaps a foreign body or a tumor present in the bronchus as a cause of the suppuration.

The X-ray may show all these things. In making radiographs in all chest cases, the upright position is the best for completeness. The diaphragm is low and the chest capacity greatest. In the prone or supine posture the diaphragm is crowded upward by the abdominal viscera and in its turn distorts the appearance of the thoracic organs. Level lines in the presence of air and fluid cannot be seen when the patient is recumbent with the rays passing from front to back or vice versa. When the patient cannot be placed upright, the exposure may be made anteroposteriorly while he lies on his unaffected side. Fluid levels may thus be demonstrated, and by taking the picture in both positions the size of the cavity can be estimated and unsuspected ones may be discovered.

Sometimes, however, bronchoscopy will reveal what the X-ray cannot disclose. For instance, the X-ray may show a triangular shadow and the history may indicate the presence of intrapulmonary suppuration; but the bronchoscopist may find and remove an aspirated lemon seed, radiotransparent, which caused all the trouble. Also, it may be convenient to know whether the pus is coming from one or more lobes when the X-ray shadow leaves one in doubt—this more as a matter of prognosis than influencing technic.

Examination of Sputum.—Examination of the sputum for tubercle bacilli is a necessary precaution. It occasionally happens that a few scattered acid-fast bacteria have been observed on one or two slides only, with numerous negative tests between. When there is a large quantity of sputum and concentration tests fail to show tubercle bacilli, in the majority of examinations, their absence may be assumed. In the cases in my list in which occasional bacilli have been found, I have an idea that there was an error in technic. Possibly the slides of two patients were confused; perhaps even the positive slide may have been a dirty one. It does not take much dirt to carry eleven bacteria, such as were found on a solitary occasion in the case of *Mrs. E. M. B.* (Case No. 1.)

Preoperative Preparation.—Two days of postural preparation are desirable excepting in the rare cases of emergency. The patient usually knows how to empty out the bronchial passages when there has been a considerable daily discharge. Sometimes the pus is more easily expelled when the patient inverts himself in the prone or in the supine position; sometimes when he lies upon the unaffected side and rarely when he lies upon the diseased side. If he has not made these observations, better take an extra day to experiment. At any rate it is best to have the lung as empty as possible so as to minimize the danger of overflow into the healthy side, especially as the patient must lie on the sound side on the operating table. The emptying should be done at least twice daily and also an hour before the operation.

As mentioned before, it is advisable to digitalize for forty-eight hours.

Three-quarters of an hour before operation a full dose of morphine and atropine should be given.

The patient's blood must be grouped and a suitable donor secured.

Precautions Against Hemorrhage.—The method of saving blood by segregating it in one or more extremities is an old one. Its practical application to surgery, however, was emphasized by the late R. H. M. Dawbarn, of New York. At the suggestion of Dr. A. J. Bendick and with his assistance the writer, some years ago, made observations with the syhygmomanometer which showed that in normal individuals the blood-pressure may be lowered by 40 to 60 millimetres of mercury following the segregation of blood in the legs brought about by ligating both thighs close to the body. We used elastic bandages and the pressure applied was just sufficient to impede the venous return, causing a swelling and cyanosis of both extremities. The blood-pressure, as shown in the pulse readings, falls rapidly, and faintness may even be induced on account of the bleeding of the subject into the veins of his legs. On removing the constriction it takes about one hour for the normal pressure to become reëstablished. According to Doctor Dawbarn, this blood segregation with its attendant lowering of pressure is of great value in preventing the loss of blood from the smaller vessels during an operation, and the writer has many times demonstrated the truth of this observation. Still, there is always the danger of recurrent hemorrhage when the normal pressure returns, because sufficient time has not elapsed for firm coagulation in the vessel-mouths. In my later cases, therefore, I have feared to employ this method and have relied more upon the intramuscular sodium citrate injections of Neuhof and Hirschfeld. When injected into the glutei just before the operation begins, while the patient is anæsthetized, a great drop in the coagulation time is noted within twenty minutes. For an average adult, 15 c.c. of a 30 per cent. solution of sodium citrate in sterile water is thrown into each buttock. The effect continues for about twenty-four hours and by that time firm coagulation has taken place. Perhaps in exceptional cases both methods might prove valuable.

Selection of Team, Anæsthetist, Assistant and Nurse.—An anæsthetist, especially experienced in this class of work, will save the surgeon much anxiety during the trying time on the table. These operations must be performed quickly and the surgeon's attention should not be distracted unnecessarily by the alarms of the inexperienced.

Whenever possible the first assistant should be a man of mature experience and a good operator who knows what to do and how to do it without being told.

I know of no class of cases in which the result is more surely influenced by the nursing than in the post-operative period of lung resection for suppuration. Mt. Sinai Hospital has been most generous in furnishing special nurses for all of these cases, and also in securing donors for blood transfusion. The changes from hour to hour, and sometimes from minute to minute, are often tremendous, the patient's condition swinging from apparent well-

being to the picture of impending death. The nurse who knows surgical thoracic cases will be prompt to sense danger; she will at once summon the surgeon, tiding over the interval with a sedative hypodermically administered.

Anæsthesia.—After consciousness has been lost following nitrous-oxide and oxygen anæsthesia, ether should be used to secure complete relaxation and deep narcosis, then nitrous oxide, using a little ether according to necessity. In spite of what we have heard from certain eminent operators from abroad as a result of their observations in the War, I know from civil as well as war experience, that when there are few or no adhesions differential pressure nearly always is an absolute necessity. I have abandoned the intratracheal for the simpler and less dangerous intrapharyngeal method. When the more healthy part of the lung happens to be adherent to the chest wall, ordinary inhalation anæsthesia may suffice, but no matter how extensive or virulent the lung infection is, unless there has been perforation into the pleura, or numerous preoperative exploratory punctures have been made, astonishingly few adhesions will be observed. In the paragraph on two-stage versus one-stage lobectomy, this matter will be discussed.

As to the apparatus required, it is of the simplest. To be sure, a nice little electric contrivance with pump and suction silently running, such as the one devised by Doctor Branower, may be a luxury, but the ordinary dental foot bellows or at a pinch even a Paquelin bulb will furnish all the air pressure necessary. A manometer when the chest is open is unnecessary because the operator can easily determine by the appearance of the healthy lung when dangerous force is being used. The pneumatic chamber is here unnecessary.

The anæsthetic, gas or vapor, passes through a rubber tube of size about 14 French for an adult, placed through one nostril, just as far as the pharynx (about $3\frac{1}{2}$ inches), the distance being clearly marked on the tube. Through too long a tube air may be forced into the stomach, a most disagreeable accident. To increase the amount of pressure, the anæsthetist places his hand over the closed lips of the patient with one finger shutting off the opposite nostril. Differential pressure may also be secured with an ordinary well-fitting nitrous-oxide mouthpiece without the nasal tube, the gas as it comes from the tank having all the necessary pressure and the balloon acting also as an indicator. Should vomiting occur, however, or should suction be required to empty the pharynx or trachea, the gas mask must be removed, thereby permitting lung collapse. I therefore prefer the tube method.

If it seems desirable to distend the healthy lung at the close of the operation, this can easily be done just before the last stitch is tied.

Posture on the Table.—The patient lies upon the unaffected side, but slightly prone, a pillow beneath the head, the back bowed forward, the thighs flexed and a thin pillow between the knees. There should be a sand-bag front, or front and back as required. Belting or bandages are used around the table, taking in the patient's thighs and legs to preserve the attitude. The arm of the affected side is raised and drawn forward so as to pull the

scapula as far out of the way as possible. The position on the table should be such that the elevating bridge comes beneath the lower ribs, and when the bridge is raised a degree of scoliosis is produced with widening of the intercostal spaces.

Should There Be One or Two Stages?—The decision between a one-stage, a two-stage, or a many-stage operation for the resection of a suppurating pulmonary lobe can be made only after the chest is opened. Here are the arguments:

First: The mere exploration of the thoracic cavity through a long intercostal incision with rib-spreading is not a shocking thing. The patients are usually out of bed in three or four days. There is no embarrassment either of respiration or of heart action, and this is true in older patients as well as in more youthful ones. But the operation takes time, and time is probably the most important element in thoracic surgery. If, now, immediately after our exploration we proceed to perform a lobe extirpation, the fifteen minutes more or less may have proved to be just enough to turn the scale.

Second: After a one-stage lobe resection, there are important changes in what may be called the balance of the heart. This is further accentuated when there is a collapse of the healthy part on the same side; and even when at the end of the operation the lungs have been distended by the differential pressure, a certain amount of collapse will quickly occur because of the rapid outpouring of exudate into the pleural sac. In young and vigorous individuals the circulation adjusts itself and the immediate danger from the operation gives place to the more remote one of infection.

Third: Suppose that at the primary operation we find numerous old inflammatory adhesions between the healthy lung and the chest wall, or suppose even that the entire pleural cavity has been obliterated by such adhesions; it is obvious then that so far as the danger of lung collapse or mediastinal commotion goes, we may as well proceed at once to complete the operation. Differential pressure is not needed; the patient breathes as quietly as if the chest had not been opened. (See case of *David J.*, No. 14.)

Fourth: It may become a matter for fine decision, however, when we find at the first operation a few adhesions of healthy lung to the chest wall. One should then observe how much collapse occurs when the differential pressure is intermitted. If the collapse seems too great, it would be better to prepare the patient for a second stage by Robinson's method (see technic); if not, the lobectomy may be done at once.

Fifth: Given a patient in good general condition with few adhesions in the chest, with practically none around the diseased lobe, and with the lobe easily removable, the decision to finish the operation at once may be made provided the entire procedure can be finished in half an hour.

Sixth: When in doubt, choose the two-stage method, but remember that the finished lobectomy means the removal of a septic focus and the instant cessation of productive cough.

The Operation.—No one will deny that in any operation unnecessary loss

of time is an evil only. Deliberateness is always justified, but it does not necessarily mean slowness; rash haste must be avoided, but steady progress with little lost motion and with quick decision means safety for the patient.

I have a feeling which is more than a mere impression, that any longer than forty-five minutes used in performing lobectomy means the almost certain loss of the patient. This has been more than once brought to my attention by Doctor Branower, my anæsthetist. Here we have one of the strongest arguments in favor of the two-stage operation, for at the second stage the removal of the sutures and the preparation for lobectomy takes only a few minutes, while the exposure alone in a one-stage lobectomy will occupy from seven to fifteen minutes. Even in suturing these wounds it is better to make a less neat closure than to lose valuable time in perfect approximation. In the checking of hemorrhage, however, there must be no careless haste.

Instead of going over the evolution of the operation as worked out in my cases, I am here describing the procedure as I carry it out at present.

Technic.—The primary incision in the 7th or 8th interspace from just behind the angle of the ribs almost to the costal cartilages should be made through the skin with a free hand. The slant of the ribs in almost all cases is much more oblique than one would imagine. Be sure, then, to keep the fingers of the left hand on the intercostal space so that the line of incision will fall correctly. Now, beginning anteriorly, the muscles are quickly divided, the first assistant taking up the bleeding points and also the uncut vessels which cross the line of incision. The muscles divided are, posteriorly, the lower part of the trapezius, the latissimus dorsi, the serratus magnus. There are formed roughly two layers of muscles, the serratus and the latissimus. The clamping of the vessels should be done quickly, taking in bits of the surrounding muscle rather than picking out the bleeding points too minutely. We now come down to the intercostal tissues and here a short incision is made in the most easily accessible part of the wound, hugging closely the upper border of the rib just below the proposed entrance into the pleura. The anæsthetist is notified that the pleura is about to be opened so that he may be ready with his differential pressure, and with the knife a small pleurotomy is made. There should be no in-and-out rush of air, the pneumatic pressure taking care of this. The pleural opening is lengthened with scissors and the ribs are drawn apart a little by blunt retractors. With strong scissors the pleural opening is rapidly enlarged to the full extent of the incision, when with steady traction the ribs are separated enough to permit the introduction of the blades of the rib-spreader, which in turn are slowly separated until in one or two minutes the widest possible space has been secured. Often six or seven inches separation may be easily obtained, and even without cutting a rib exposure enough for the purpose of the operation may sometimes be had. If the space does not widen sufficiently it is possibly because the posterior intercostal structures require further division. For a lung resection, it is necessary to have a very wide approach, especially when we are dealing with the upper lobe. Then the 7th, or even the 6th space intercostal incision will have to be supplemented by continuing its posterior end upward parallel with the posterior border of the scapula and about one inch or more from it. The rhomboid muscles must be divided and three or four ribs cut through with heavy bone forceps without taking the time to peel away the periosteum. A spinal forceps or a heavy Liston's bone forceps will be found convenient for this purpose and the cutting edge should

be in a plane at right angles with the plane of the rib instead of parallel with it. The cutting is done very slowly so that the intercostal structures are crushed before they are divided, thus minimizing the chance of hemorrhage from the artery. This rib division goes straight through into the pleura. Should there be bleeding from the intercostal when the rib first cut is severed, ignore it and proceed quickly to cut the next rib, at the same time separating the blades of the rib-spreader farther. This will give easy access to the bleeding point. When a sufficient number of ribs have been divided, a second rib-spreader may be placed in the vertical part of the wound; or a single blunt retractor placed anteriorly will draw the ribs forward. This incision is the one devised by Torek in his operation for the transpleural exposure of the thoracic œsophagus.†

When the operation is to be divided into two stages the making of this vertical part of the wound may be postponed according to the condition of the patient. If during the first spreading of the ribs, particularly in older subjects, a fracture occurs no harm will come of it. The accident is an unusual one. Sharp points should of course be trimmed away.

As soon as the exposure is made, a glance will show the gross pathological relations between the lungs and chest wall, and also the condition of the lung itself. The intermission of the intrapharyngeal pressure will cause the healthy lobe, and in a measure the diseased one, to collapse, indicating the location of adhesions. These are of two kinds; either the broad, dense variety which often signify pus beneath, or the more attenuated, cordlike kind which can easily be divided between catgut ligatures. It is best not to disturb adhesions of presumably healthy lung to chest wall.

The diseased lung may be bluish, brownish or, rarely, pale. It is most often solid and liver-like in feel, and is in sharp contrast with the healthy pulmonary tissue.

If this is to be the first stage only, the healthy, non-adherent lobe and also the costal pleura with which it is normally in contact should be briskly rubbed with gauze and then the lobe should be surrounded with several single layers of iodoformized gauze, about 3 inches wide, placed one beside the other, the ends long enough to reach outside the wound in the chest wall. This employment of gauze to form adhesions I learned in a personal communication from Dr. Samuel Robinson. These pieces of gauze are transfixed in one mass with a safety pin which is left outside the muscular layer of the chest. The place where the safety pin lies should be marked on the skin so that two days later it can be quickly found on the removal of one or two cutaneous sutures. This gauze must be withdrawn in 48 hours. Its extraction is sometimes quite painful, and if the patient is nervous it can be done under light nitrous-oxide anæsthesia. It takes only a few seconds. If it seems desirable the diseased lobe may be surrounded with a large piece of rubber dam to prevent the formation of adhesions. This rubber dam need not be led out at the wound. It is not to be removed until the second stage of the operation. The entire wound is now closed, as will be described in speaking of this stage of the completed operation, excepting that the skin is sutured covering in the gauze, safety pin and all.

One week after the first operation the second stage may be undertaken. By this time firm adhesions will usually have formed between the healthy lung and the thoracic wall, and with the danger of post-operative lung collapse, the danger of mediastinal flapping is also banished. The necessity for differential pressure no longer exists, so that the second stage of the operation, the lobectomy itself, can proceed with the least possible respiratory embarrassment, and even with ordinary inhalation anæsthesia.

† The cutting of the intercostal nerves is sometimes followed by pain in their distal distribution. Neuhof has used alcohol injections to combat this.

RESECTION OF THE LUNG FOR SUPPURATIVE INFECTIONS

The Lobectomy itself; Primary or Secondary.—The pulmonary ligament, that fold of the pleura between the pericardium and the lower mesial part of the lung, contains no vessels of importance and it can be quickly divided with scissors. The pedicle of the lobe is now isolated and carefully palpated. In the chronic inflammatory cases this structure is densely infiltrated and its texture is almost that of solid rubber. To separate this pedicle into its elements of bronchus, blood-vessels and nerves would take too long, even if it were possible. Therefore, the pedicle is to be secured with chain ligature sutures of stout, but not too thick silk. In some cases the pedicle can be first crushed with a powerful clamp; in others it is too thick and tough for any clamp, but even here it can be crushed in sections, each section being caught immediately after crushing with a large hæmostatic needle and firmly ligated. The placing of these chain ligatures, taken one next to the other so that no part of the pedicle can escape ligation, is the most important part of the operation; for if one of them slips or breaks there will be such a rush of blood that the vessel lying at the bottom of the opaque pool can never be secured. A large stump should be formed by sectioning the lung tissue, whether diseased or not, an inch or even more distal to the ligatures in the pedicle itself. This should be done slowly with scissors or knife, an assistant wiping away discharge or using suction so that there shall be a minimum spilling from the distal part of the lung. When the ablation is complete the stump must be carefully inspected and all apertures, especially the bronchial openings, wiped out with pure phenol.

Thus far I have assumed that infecting the pleura at the time of operation is unavoidable. Packing off with gauze is only a makeshift and cannot be carried out as it is done in the peritoneum where the viscera have a natural tendency to crowd toward the wound. In the thorax the lung tends to fall away from the wound and infected fluid exudate can hardly fail to become pretty freely disseminated. Following the slow perforation of a lung abscess we often see the formation of sacculated or localized empyema. In the sudden breaking of an abscess, however, a general rapidly forming empyema results; so in these operations when a bronchus or an abscess filled with septic fluid has been entered there is a great gush of pus with immediate extensive soiling of the pleura. Or if there is a protective packing it becomes infected and it is almost impossible to remove it without contact with the pleura. Then, also, it has not been possible actually to sterilize the stump because it is nearly always composed of grossly infected tissue which is supposed to slough off later on. To keep this sloughing stump from the uninfected pleura during the ten to fourteen days before it is cast off appears to me to be at present beyond our skill. The most that we can hope to accomplish is to minimize the soiling so that the invasion of the infection may be slower, permitting the patient sufficient time to acquire resistance.

Following the suggestion of Doctor Neuhof, in some of our cases I have tried to accomplish this temporary protection with the aid of rubber dam. For many years I have made use of rubber dam in my gastro-intestinal work, with great satisfaction. In the lung surgery, however, I have not tested it out sufficiently to know its possibilities. Perhaps if a device can be found for completely isolating the diseased lobe before ligating and ablating it good might be accomplished. I shall continue to experiment along these lines.

The ends of the silk ligatures will have been left long so that they form a bundle of ten or twelve strands that should be tied together with another piece of silk placed so that a large transfixing safety pin will lie upon the chest wall beneath the level of the skin, causing just enough tension upon the pedicle to steady the mediastinum when the patient coughs or strains.

The anterior portions of the cut ribs should now be shortened about an inch

for two reasons: first, to prevent their grating during the early part of convalescence—a disquieting sensation for the patient; and second, to leave room for the bundle of ligatures and for the removal of the stump when it shall have sloughed away. The ligatures and stump are drawn through a hole in the center of a piece of rubber dam which is now slipped down over the stump and embraces what may be called its neck. This rubber dam now forms a sac with the stump at the bottom, and within this sac down to the stump is placed a packing of iodoformized gauze. The rubber dam with the gauze and ligatures in one mass is led out through the upper part of the thoracic wound and marked with a safety pin. In addition to this opening for drainage another smaller one is made through the lower chest wall posteriorly, with or without resection of a small piece of rib; and this opening is made before the closure of the chest and under the guidance of the hand within the thoracic cavity. It should come just above the diaphragm and should be large enough to take a tube of about 28 French. If necessary, a suture of the skin alongside the tube should be made for the sake of airtight fitting. The intrathoracic portion of this tube should have several fenestræ and should be long enough to reach almost to the level of the pedicle (see Fig. 21). The chest is now closed with three or four pericostal sutures of heavy chromicized catgut or kangaroo tendon and one row of chromicized catgut interrupted sutures for each layer of muscle. In closing the chest this muscle suture will be rendered much easier by lowering the bridge and placing the patient's arm down against his side. The drain, rubber dam, etc., with the safety pins is buried beneath the sutured fascia to be removed for drainage on the removal of these sutures in two days.

Under no circumstances, no matter now tempting, should the skin ever be sutured after lung resection for suppuration. The danger of anaërobic infection is great and I have seen more than one patient die of a gas phlegmon beneath what looked like a perfectly clean and innocent cutaneous suture line. The wound in the skin should be packed with iodoformized gauze. In a few days, if all is well, the gauze may be removed and the skin edges strapped.

The tube from the lower part of the chest is clamped after the lobe of lung has been distended by the intrapharyngeal pressure, and as soon as the patient is in bed this tube is carried beneath the surface of antiseptic liquid in a vessel on the floor. Kenyon's drainage.

Dressing.—It has been my rule to forbid an encircling bandage to be placed around the chest immediately after this operation. The gauze is held in place with broad adhesive strips, going not more than two-thirds round the body. These patients must have rest; to encircle the chest with a bandage, gauze, or plaster, means an unnecessary effort with each respiration.

After-Treatment.—Considerable shock usually follows the operation with rapid pulse and respiration. To combat this, morphine in large doses should be administered, regulating the quantity according to the rapidity and character of the breathing and striving to reduce the rate to something under 30. A rapid pulse is not in itself a sign of immediate danger provided its volume remains sufficient, but respiratory distress, either with or without cyanosis, is a cause for alarm.

Transfusion.—After almost every lobectomy there is a large outpouring of bloody serum into the pleura. This serum is intensely stained, looks almost like fluid blood, and I have known it to show as much as 11 per cent. hæmoglobin. Therefore, unless the patient is in exceptionally good condition, with normal blood pressure and hæmoglobin, I think it is well to, as the financiers say, "discount the condition" by a timely blood transfusion. I have usually done this immediately after the operation, and indeed, as I have before stated, I will not prepare for a lobectomy unless the patient has been grouped and the appropriate donor is pres-

ent. If during the operation much blood is lost and the patient is in shock from acute anæmia, a transfusion with citrated blood may be performed because the method is quick and easy. If there is plenty of time, however, I prefer one of the more direct syringe methods instead of the citrated blood. The citrated blood sometimes causes a sharp reaction with chill and hyperpyrexia. In such a grave operation as lobectomy, all the resisting powers of the patient must be conserved, and I feel that in certain of my cases we cannot be sure that the reaction chill did not contribute definitely toward a fatal termination.

After-care and Post-operative Phenomena.—One of the most dangerous complications following an operation upon the lung itself, especially in suppurative cases, is infection by anaërobic organisms. It occurs in nearly every case and often there is a condition greatly resembling the gas gangrene of war wounds. Very little has been done toward the cataloguing of these various organisms. Through research in this field we may hope for the discovery of vaccines which will minimize the risk from infection. On the assumption that anaërobes abhor oxygen, surgeons in the past have made use of the open treatment of infected wounds of other regions, exposing them to the air; and in later days peroxide of hydrogen has been employed. I have frequently used oxygen in open infected thoracic wounds, placing a small catheter in the chest and permitting the gas to bubble through continuously for two or three days, the great size of the wound preventing the danger of tension. I have never considered it proven that this procedure has actually shortened the time of anaërobic infection, but it can do no harm, and when our figures are large enough we may learn more about the value of this form of therapy.

Tension Pneumothorax.—This variety of pneumothorax in which there is progressively increasing pneumatic pressure may occur from within or from without. It usually means that during respiratory effort, whether in breathing, coughing or straining, air enters the pleural cavity which is retained there and prevented from escaping by the valve action of the opening through which it entered. The tension may increase rapidly or slowly according to the amount of air which enters at each cycle, but sooner or later, either in minutes or hours, the pressure becomes so great that the organs of the mediastinum are displaced, that the flow in the veins is impeded, and that respiration gradually becomes impossible. To relieve the condition, it is only necessary to open the tense chamber, equalizing pressure without and within. This had better be done slowly at first so that there may not be too sudden a swinging back of the mediastinum to its normal position. If the pneumothorax is general, relief may be had by opening a part of the wound. If it is sacculated and cannot be reached by way of the wound, puncture should be made through the unopened part of the chest where the physical signs indicate the trouble. A fine trocar and cannula is the proper instrument, and with the aid of an attached rubber tube, its end under water, the bubbling of the escaping air may be observed. If it is desired to secure a negative pressure within the chest, the patient should be requested to strain repeatedly, the

tube being pinched with each inspiration until no more bubbles appear on expiration; then the needle should be quickly withdrawn. What we have accomplished can often be determined by means of the X-ray. The relief afforded is striking. A tension pneumothorax may overflow into the external tissues or into the mediastinum through small openings, causing subcutaneous or mediastinal emphysema; and if this becomes in itself alarming it can be relieved by suction with a cupping glass, or Bier's apparatus, through incisions in the skin. Another danger of this pneumatic tension in the thorax is air embolism.

For the first twenty-four hours after the initial reaction following the operation, there is little to do. The patient seems surprisingly well and breathes easily. Any sudden dyspnoea in this period would probably signify the slipping of a bronchus from its ligature and a tension pneumothorax.

Hemorrhage will be recognized by the classic signs.

In forty-eight hours the wound should be inspected, and in not more than three days the muscle sutures covering the ligature bundle are removed and this part of the wound examined. The gauze within the rubber bag is loosened, but should not be removed unless it comes away with great ease. The lower drainage tube is cut off short and secured with a pin in the usual manner. Anaërobic infection with its gangrenous stench becomes evident. There may be some marginal sloughing. This foul odor will persist until the stump comes away—in ten to eighteen days, occasionally still longer. Then the bronchial fistulæ will appear with their whistling which often annoys or alarms the patient. Rarely, even at this date, there may be distress from mediastinal motion which can be relieved by an occlusive wet dressing. The chest being now wide open, the danger of tension pneumothorax is past. Rarely tension pneumothorax may even then occur as a sacculated form behind adhesions.

Gradually granulation sets in and the wound heals down to two fistulæ, one above, and the other where the tube is. The upper wound may be permitted to close as soon as it will, but the lower should be kept open until it has become a mere track, when the tube may be removed, the bronchial fistulæ having usually closed by this time. Dakin's fluid cannot be used with safety in these chest wounds with their wide-open bronchi. Yet an aseptic pneumothorax may form and the X-ray may reveal this condition months after the patient has fully recovered.

In nearly all my cases there have been occasional slight hæmoptyses weeks or even months after complete external healing has taken place. I have never had one of these patients bronchoscoped, but I believe that the source of the bleeding is probably granulation tissue at the site of the closed bronchus. These hæmoptyses have never been serious, and it is my custom to warn each patient when he is discharged that he may expect occasional slight blood spitting. Otherwise he is apt to become panic-stricken and to feel that his case is a failure. There is no fever, and I have never found it necessary to demand even rest in bed when such a little hæmoptysis occurs, but I do advise

a radiographic examination. Thus far, no patient who has shown this symptom has developed any recurrence or other serious complication in consequence.

A day or two after the safe sloughing off of the stump, the patient may sit out of bed. He will not be actually healed, however, short of two or three months, and cannot be considered well for a much longer time. I have seen moderate cough at intervals even with a little sputum for the greater part of a year, yet with complete final recovery. In most of the cases, during the period of healing and until the wound is entirely closed, it has been found that the slightest disturbance in the patient's general condition has been followed by a rise of temperature. Even a little unusual exercise has been followed by slight fever as in tuberculosis. The greatest patience and attention to detail, with frequent visits of the surgeon, are necessary to success. And above all price is a tried and experienced nurse.

I have carefully read what Sauerbruch has to say on suppurative bronchiectasis in his 1920 work on thoracic surgery—a scholarly and beautifully made book. As to the merit of his methods of treatment, however, including his technic of lobectomy, I am far from convinced. Persistent bronchial fistulæ, deforming thoracoplasties, probably no patient actually cured—these results do not appeal to me. It would almost be better not to try to do a radical operation. He reports (*loc. cit.*, pp. 588–589) three cases of lobectomy for bronchiectasis based on animal experiments. The operations were done through intercostal incisions, the vessels of the pedicle were ligated, and the bronchi were closed by ligature and inversion. The chest was closed without drainage. No wonder all three patients expired from tension pneumothorax six days later. The same results followed a case similarly treated by Friedrich. Sauerbruch, from his experience, rashly concludes that one-stage lobectomy should be abandoned. He might, perhaps, have saved all three of his patients by a more surgical technic. These cases cannot be treated by attempting permanent closure of the bronchi at the time of resection, as might be feasible in the aseptic cases, such as the removal of tumor-bearing portions of lung. In the suppurations the bronchi will surely reopen a few days after operation, and this should be expected and provided for.

Sauerbruch also (*loc. cit.*) extirpated a lobe in nine other cases by the many-stage method. *There were no cures*, five were considerably improved, two were slightly improved, and two died. Again he reaches the unwarranted conclusion that a cure in the true sense of the word cannot be accomplished.

Robinson's technic is founded on correct surgical principles and promises good results. Its outstanding disadvantage is the approach by rib resection which leaves an unnecessary degree of contracting deformity. Some contraction of the chest is unavoidable after the removal of an entire lobe, but much of the dead space should be filled by the other lobe which becomes hypertrophic, and perhaps what might be called physiologically emphysematous, and also by the compensatory raising of the diaphragm on the same

side. The surgeon need not provide for this filling of space for Nature is able to take care of it.

Post-mortem Examinations.—Even when an operation through an ample incision has made us believe that we have noted all gross pathological conditions relating directly to the operative part of the case, a carefully performed autopsy will often bring out unrecognized or even unsuspected facts from which much can be learned. Through a so-called “wound inspection,” when the opening has been large enough, an almost complete autopsy may be performed. It omits, however, the cerebrospinal system, in which secondary or metastatic foci are peculiarly apt to appear in pulmonary operations.

We have been recently especially fortunate at Mt. Sinai Hospital in having for our assistant-director, Dr. E. M. Bluestone. He comes in contact with the families of the patients and he has the necessary tact to deal with the situation so that through him we have secured 80 per cent. of autopsies. His example may well be called to the attention of those in charge of similar institutions.

Cases of resection of the lung for suppurative disease are the most trying ones in all surgery. The high mortality, the sudden and often disappointing changes, the repeated crises, the numerous complications, and the prolonged convalescence with no feeling of security until long after the wound is healed, would hardly be worth the tremendous effort were it not for the unequalled gratification in the final success. To have been the instrument of restoring one of these wretched beings to blooming health after months or years of revolting illness with the constant fear of fatal pulmonary hemorrhage is the richest reward that surgery can offer.

CONCLUSIONS

1. Chronic pulmonary suppurations wholly or partially of the bronchiectatic type are rarely curable without the extirpation of the pathological focus.
2. The surgical removal of a single pulmonary lobe for chronic pus infection has a mortality of about 42 per cent. The danger is much greater when more than one lobe is infected or in the presence of other complications.
3. Remissions of weeks or even months may occur spontaneously.
4. Palliative operations may be followed by improvement, rarely by apparent cures.
5. The commonest cause of the disease is infection due to the aspiration of infected material during tonsillectomy.
6. Radical operation should not be undertaken short of several months after the onset unless the disease is obviously spreading.
7. The proper type of operation should be determined only on full exposure by thoracotomy.

Here are brief abstracts of the histories of all my patients. All have been followed up to date except Case No. 14 (David J.), who was followed for two years, and at last account was well. Pathological study of all speci-

mens has been made by Dr. Paul W. Aschner, Adjunct Surgeon and Assistant in Pathology, Mt. Sinai Hospital, and the results are here reported by him. It is most interesting that in going over the material together, the histological findings placed the cases in the same group in which they had been put by me immediately after operation. The literature was searched by Dr. S. Hirshfeld who furnishes references and brief abstracts of interest.

CASE I.—*Suppurative Bronchiectasis Following Tonsillectomy; Lobectomy; Middle Lobe.* This case has been reported in the *ANNALS OF SURGERY* for July, 1916. The following is a brief abstract:

Mrs. Elizabeth M. B., age thirty-three, came to me twenty-two months after her tonsillectomy in general anæsthesia. Characteristic symptoms of lung abscess had appeared ten days later. When I saw her in October, 1915, I found her general nutrition good in spite of frequent attacks of fever. There was clubbing of the finger tips and a productive cough with as much as a quart of stinking secretion in twenty-four hours.

Operation.—On October 18, 1915, in nitrous oxide, oxygen and ether administered by Doctor Branower, in a little less than an hour the middle lobe was extirpated. Loss of blood slight. Pulse after operation 140.

Post-operative Course.—The day following the operation there was considerable shock, respirations up to 60, pulse 144. This was probably owing to the accidental omission of morphine during the night. Almost immediately after giving a hypodermic of one-fifth grain of morphine and one-two hundredth grain of atropine the respirations dropped to 30 and the pulse to 120. This medication was repeated every four hours. The usual bronchial fistula appeared, but closed spontaneously and the patient was discharged well on December 20, 1915. A few times after her discharge there were slight hæmoptyses, but the patient may be considered perfectly well and leads a normal life.

CASE II.—*Lung Abscess Following Tonsillectomy—Resection of the Left Upper Lobe.* Mrs. C. M., twenty-eight years old, came to me July 10, 1917. Tonsillectomy in general anæsthesia had been performed about April 1, 1917. The operation was difficult owing to the friability of the tissue and it lasted about three-quarters of an hour. Ten days later there was cough followed by profuse, foul, purulent expectoration. When I first saw her she was coughing twelve ounces of foul mucopus a day and three days before there had been an hæmoptysis of about eight ounces.

X-ray examination in the recumbent position resulted in a diagnosis of single abscess in the left upper lobe. After the patient had entered the hospital, however, a second X-ray examination was made in the upright position and another with the patient lying on her sound side. These showed "a dense infiltration which extends from the left apex down to the level of the third rib anteriorly, involving approximately the left upper lobe. This has the appearance of a pneumonic consolidation. Just beneath the middle of the left clavicle there is an oval cavity about one and one-half inches in diameter which is half-filled with fluid. It shows a fluid level which shifts on change of position. The heart is somewhat displaced toward the right. The remainder of both lungs appears to be uninvolved" (Wessler).

In this case, on account of the tendency to hemorrhage, it was decided to dispense with bronchoscopy and to proceed at once with the surgical therapy.

Operation.—Operation was undertaken on the inauspicious day of Friday, the thirteenth, in July, 1917, in the Private Pavilion of Mt. Sinai Hospital, Dr. Martin W. Ware and Dr. A. O. Wilensky assisting. The anæsthetic, given by

the intrapharyngeal method, was ether and oxygen administered by Doctor Branower. A preliminary ligation of the upper part of the thighs reduced the systolic blood pressure from 125 to 115 by blood segregation. A long incision was made at the sixth interspace with removal of six or seven inches of the sixth rib with its periosteum. The sixth, fifth and fourth ribs were divided near their angles through an incision carried upward along the border of the scapula. A rib-spreader was put in. No adhesions were encountered in the lower chest, but upper and lower lobes were adherent to each other and the lower lobe slightly adherent to the posterior chest wall. The abscess was quickly identified by the dark color and liver-like consistency of the lung. A small abscess was entered in peeling away the lower from the upper lobe, and going a little further the main abscess was entered and found to be much larger than would have been judged by the X-ray, much of the opacity having been due to the presence of pus without air and also to the great density of the surrounding infiltrated pulmonary tissue. Most of the adhesions between the upper lobe and the parietes were easily broken down, but a few had to be ligated. The upper lobe was nicely mobilized and its apex found to be apparently healthy. The main abscess, which was now widely opened, was disinfected with phenol, and all inflamed and infected tissue was excised between ligatures of chromicized catgut. Hemorrhage was not great but the blood-pressure during the operation gradually fell to about 60, even after both ligatures had been removed from the thighs, letting in the segregated blood. The diseased part having been removed Doctor Branower was able to demonstrate the permeability of the bronchi to the upper and lower lobes by inflating them with his intrapharyngeal apparatus. Other suture ligatures were placed around small parts of the uninvolved upper lobe and were sutured to the chest wall in order to steady the mediastinum. The stump was also sutured to the parietal wound and its hollow packed with iodoformized gauze. At the ninth interspace posteriorly a small incision was made into the thorax and a rubber drainage tube fastened there airtight. The wound was now closed throughout by muscular and then cutaneous sutures in such a way as to close the chest, entirely burying the tube, gauze and drainage material. This was done so as to make respiration easier for the first forty-eight hours, when it was intended to reopen the suture line at suitable points for drainage.

Post-operative Course.—Following the operation there were many days of anxiety. The respirations, however, averaged only about thirty-eight and the pulse about 134. Four days after the operation the anterior part of the wound had to be reopened to drain the thoracic wall, which was filled with foul pus, the product of infection by anaërobic organisms. There was also some subcutaneous crackling on palpation. The thorax had been opened for drainage two days before and more than twenty ounces of intensely bloody serum evacuated. This serum measured up to ten per cent. in hæmoglobin but there were no clots. Because of the anaërobic character of the infection I passed oxygen through the chest for several days by attaching a drainage tube to the oxygen tank and permitting the gas to flow through at the rate of about two bubbles a second. Eight days after operating the packings were removed from the upper part of the chest and this was followed by slight, though annoying, cough which continued in scattered paroxysms for four more days, when a bronchial fistula appeared and the cough ceased. There was continued general improvement, however, and the patient sat out of bed for the first time twelve days after the operation, although she was still very weak. The pulse was 120, the temperature running to 101 and the respirations to thirty. About four weeks post-operative the healing process had divided the chest into two distinct chambers, an upper and a lower one. The upper discharged foul pus, the lower non-odorous. The upper wound was packed daily with iodoformized gauze. The ligatures came away about three weeks

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after the operation, carrying with them a large pulmonary slough, and there was an immediate change for the better. Anaërobic infection, subcutaneous in character, appeared and the anterior part of the wound had to be opened. This pocket was in the chest wall only. It was quickly disinfected and healed nicely under the Carrel-Dakin treatment. The pulse at this time was usually below 100, respirations about twenty and temperature in the neighborhood of $100\frac{1}{2}^{\circ}$ to 98.4° and the patient was walking about.

Mrs. M. was discharged from the hospital the latter part of August with a tiny thoracic fistula from the lower drainage opening. It soon closed spontaneously and has remained closed.

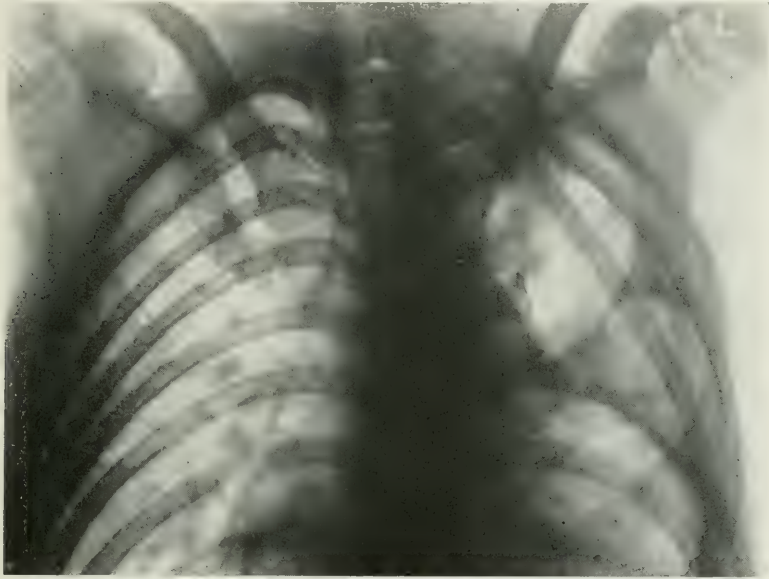


FIG. 1.—Case 2. Mrs. C. M. Resection of left upper lobe, four years after operation. Patient well, all wounds closed for nearly four years. Function of arm and shoulder perfect. Small aseptic pneumothorax. Upper ribs contracting upper part of chest. Bridge of new bone connecting rib stumps.

For more than a year there were occasional exacerbations with cough and slight expectoration, not foul in character. Each of these appeared as the result of a "cold" and finally ceased altogether. Recently this patient went through a severe typhoid fever with intestinal hemorrhage, for which a blood transfusion had been necessary. There was also a little cough, and her physician, Doctor Hanan, feared that the cicatrix in the lung might be breaking down. An X-ray examination was made. The lung did not necrose, however, and the patient made a splendid recovery from her typhoid and is well at the present time with no indications of active thoracic disease. (See Fig. 1.)

CASE III.—*Bronchiectatic Lung Abscess Following Tonsillectomy—Sub-total Pneumectomy.* This case has been reported in *Surgery, Gynecology and Obstetrics* for November, 1919. A brief abstract follows.

W. A. B., a man twenty-six years old, had had his tonsils removed in general anæsthesia and there developed a suppurative bronchiectasis with abscesses of the right lower lobe, the middle lobe and part of the upper lobe. I first saw him fifteen months later, on March 14, 1917, in the private ward of Mount Sinai Hospital. The case had been steadily progressive, the first symptoms appearing

about a week after his operation. At my first examination this patient looked almost moribund. His temperature was 104° and his appearance was that of a person in the last stages of tuberculosis. I hesitated to operate. He and his family, however, begged for relief and were willing to accept almost the worst possible prognosis if only something could be done, for it was recognized that he would die perhaps in a few days longer.

The X-ray examination showed lung involvement from the second rib down to the base where the diaphragm was drawn up by adhesions. There were a number of cavities with fluid levels. The left chest was apparently normal. In spite of the long duration of his illness there was but little clubbing of the fingers. Blood-pressure was 100 over 65.

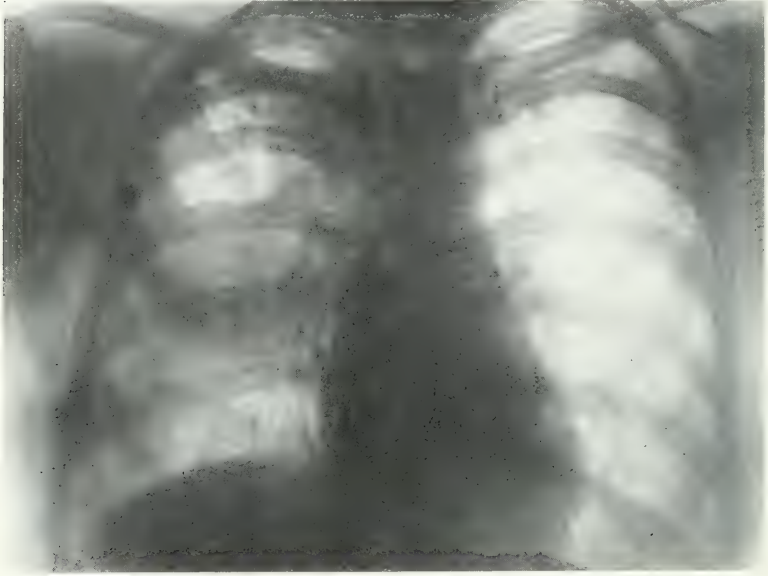


FIG. 2.—Case 6. Miss J. K. Preoperative. See history. Upper and lower lobe disease.

On March 16th, Doctor Yankauer bronchoscoped the patient in general anaesthesia with nitrous oxide and ether and I was in hopes that it might be possible to wash out some of the pus prior to operation. Owing to the patient's wretched condition this attempt had to be abandoned but the procedure consumed about fifteen minutes. I then operated, Doctor Branower continuing the anaesthesia and Doctor Ware assisting at the wound. The thighs were ligated with elastic ligatures to segregate the blood during operation.

Operation.—A long seventh interspace incision was made with resection of the greater part of the seventh rib and section of the sixth rib posteriorly. The chest contained straw-colored fluid and covering a part of the posterior portion of the upper lobe there was a coating of lymph. In peeling away the lower from the upper lobe a large abscess cavity was entered. The lower and middle lobes were removed beyond mass ligatures of chromicized catgut and heavy silk. Very little hemorrhage occurred. The chest was temporarily closed with drainage after about a pint of paraffin oil had been poured into the thoracic cavity and left there. The stump was carbolized and iodoformized gauze placed against it. Immediately after operation 500 c.c. of citrated blood were transfused by Doctor Wilensky. A gangrenous condition of the wound developed and it had to be

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opened widely. Oxygen in a slow stream was passed through the thoracic cavity for two days but without appearing to influence the anaërobic infection. The wound was then packed lightly with iodoformized gauze and improvement followed. With the chest wide open it was seen that we had evidently included much—if not all—of the pedicle of the upper lobe in the ligatures and that this upper lobe had so far contracted that it could not be seen. The usual bronchial fistulæ formed, but gradually the patient picked up and was finally sent to his home with a thoracic sinus which I feared to permit to close on account of the open bronchi. It closed spontaneously, however, and the patient was shown before the American Society for Thoracic Surgery at its meeting in Atlantic City on June 9, 1919, apparently entirely well and with the thorax firmly closed. The general condition was excellent. He was working and said that he could exercise without undue fatigue and mentioned particularly that he had danced seventeen

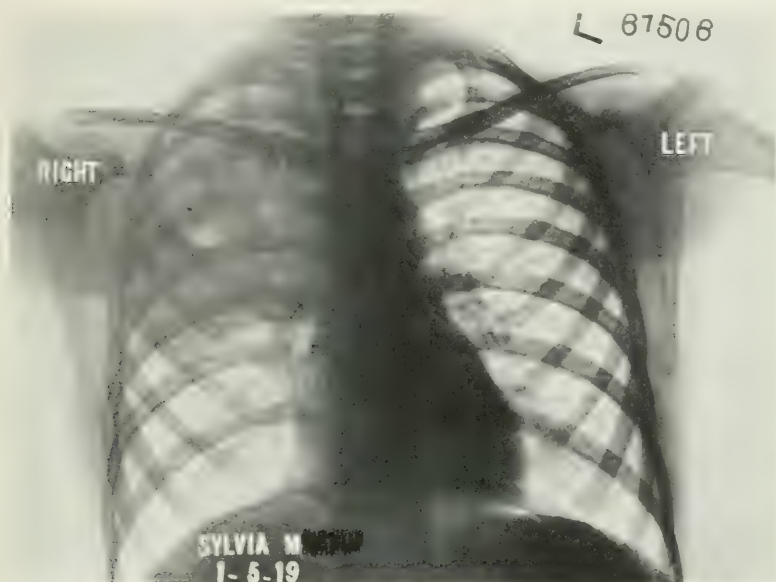


FIG. 3.—Case 7. Sylvia M. Preoperative. Right upper lobe bronchiectasis with cavitation.

dances in succession without distress. Since that time the wound reopened twice and the patient, who is very intelligent, preferred the presence of a small tube in his thoracic sinus rather than the annoyance of the occasional fillings. The discharge is very slight and the patient with this exception may be considered entirely well. He has married twice since his operation.

CASE IV.—Post-Tonsillectomy Lung Abscess (Bronchiectatic)—Two-stage Lobectomy—Death. Miss S. K., sixteen years old, was admitted to the Medical Service at Mount Sinai Hospital on May 7, 1917. About April 15th of the same year tonsillectomy in general anæsthesia had been performed and there developed fever, cough, pain in the chest and purulent expectoration.

X-ray examination showed a cavity two inches in diameter in the right lower lobe with a beautifully marked fluid level.

Under medical treatment this cavity became much smaller, the symptoms were relieved and the patient was discharged on April 10th and sent to the country. A month later she was readmitted to Doctor Manges' service with her symptoms just as bad as ever. She was transferred to me on June 3rd and I

operated the same day in local anæsthesia. An abscess was found in the upper part of the right lower lobe. Adhesions were separated but nothing further was done.

June 6th, the patient going down-hill rather rapidly, I removed the right lower lobe, and during the operation she received 600 c. c. of blood by the citrate method. She died two hours after the operation.

The specimen showed an abscess one and one-half inches in diameter in the right lower lobe.

CASE V.—*Bronchiectatic Lung Abscesses Following Tonsillectomy—Extirpation of Right Upper and Middle Lobes—Death.* Miss E. B., thirty-three years old, was brought to me on July 11, 1917, by her physician, Doctor Chappell, of Middletown, N. Y. About two years before her tonsils had been extirpated under general anæsthesia, and thirteen days later there was cough with foul

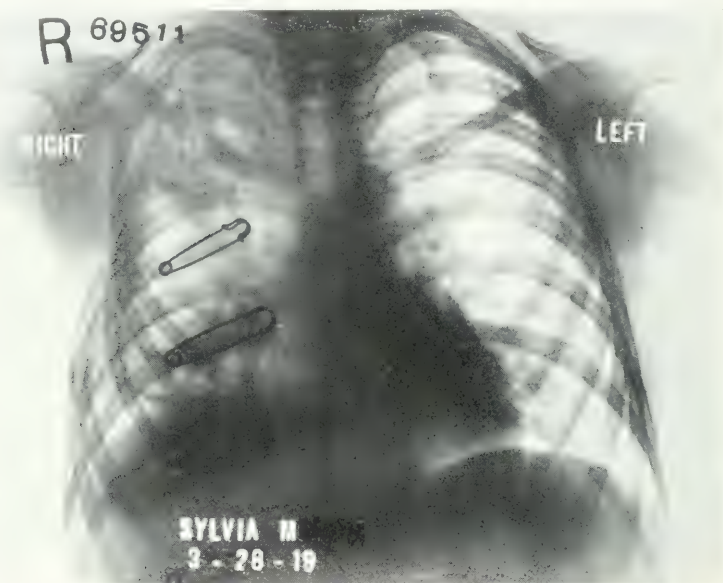


FIG. 4.—Case 7. Same patient, 38 days after operation. At the present writing chest is clear.

expectoration and fever. Thereafter with brief periods of remission the symptoms had been practically unchanged. Her temperature ranged between 100° and 105°. She stated that she sometimes expectorated as much as one and one-half pints during one emptying. There were repeated hæmoptyses. The fever in this case was high during the periods of greatest expectoration.

The X-ray showed apparently an abscess of the middle lobe.

This patient had been at Saranac Lake, although no tubercle bacilli had been found. The other lung was healthy.

Bacteriological examination showed the continuous presence of streptococcus. After admission to Mount Sinai another X-ray picture was made and Doctor Wessler reported abscess of the upper lobe.

Because of the unbearable condition, together with the danger from frequent hæmoptyses, I decided to operate. The patient entered the Private Pavilion of Mount Sinai Hospital, and on July 17th in nitrous oxide and ether anæsthesia by Doctor Branower (intraparyngeal method) I operated. Doctor Ware and

Doctor Wilensky assisted at the operation. Blood segregation had been secured by means of elastic ligatures placed about the thighs.

Operation.—A long sixth interspace incision was made and a long piece of the seventh rib was at once resected. The fourth and fifth ribs were then divided posteriorly. It was at once seen that although the lower lobe was apparently healthy the middle and upper lobes were diseased. They were dusky and hard to the touch, expanding and contracting little with respirations. There were numerous dense adhesions above but none below. In one mass the upper and middle lobes were ablated beyond ligatures of chromicized catgut with two of silk. Hemorrhage was inconsiderable but the patient's condition was poor, although the systolic pressure did not go below eighty. It had been 125 before operation. The stump was carbolized and fastened to the chest wall. A counter-incision in the ninth interspace behind was made for drainage and the wound was temporarily closed without drainage. She received 300 c.c. of citrated blood. There was cyanosis but no embarrassment of respiration. Six hours after operation the condition appeared good, the pulse was 160, but of fair quality. Fifteen hours after operation, however, there came a change for the worse, with cyanosis and weak and rapid pulse. One hundred and fifty c.c. of citrated blood which had been saved from the first transfusion were now put in. The patient did not rally, and died thirty-one hours after the completion of the operation with a sharp rise of temperature to 105°. No autopsy permitted.

CASE VI.—Bronchiectatic Lung Abscesses of Upper and Lower Lobes following Tonsillectomy. Extirpation of Lower Abscess.—Miss J. K., thirty-two years old, was sent to me on September 8, 1917, by Doctor Waring, of Denver. Tonsillectomy had been performed three years before in general anæsthesia. The tonsils were imbedded and the operation difficult. Thirteen days later there appeared cough, fever and the other usual signs of lung abscess. The fever became remittent with attacks every two or three months accompanied by foul expectoration. There was clubbing of the fingers. No tubercle bacilli were found upon repeated examination. Patient's general condition appeared to be good and there was no organic disease other than that mentioned.

X-ray pictures taken in Denver and retaken by Doctor Wessler in New York, showed what appeared to be an abscess near the hilum of the middle lobe partly involving the upper. Adhesions to diaphragm were evident. (See Fig. 2.)

The patient had been unable to work for three years and both she and her family were willing to take the chance of an operation.

She entered the ward of Mount Sinai Hospital, and on September 20, 1917, I operated. Intraparyngeal anæsthesia by Doctor Branower. Segregation of blood was attained by ligation of the thighs. The blood-pressure before operation was 122 systolic, 88 diastolic.

Operation.—A sixth interspace incision was made and large parts of the seventh, sixth and fifth ribs were resected posteriorly. The rib-spreader was put in and it was then found that the middle lobe was the only one of the three which was absolutely unaffected. In the lower lobe a dense abscess was adherent to the posterior chest wall near the spine and there was another in the upper lobe. The two lobes, however, could be easily separated by loosening the attenuated adhesions. General adhesions about the upper lobe held it to the chest wall so that it did not collapse. The adhesions to the diaphragm were now cut loose and the abscess of the lower lobe was extirpated in the usual manner with chain ligatures of chromicized catgut. Soon after the operation began the blood-pressure commenced to drop and the ligature about one thigh was loosened. Even after this, however, the blood-pressure was under eighty. The operation up to this point had been quickly done, but it was decided not to disturb the upper lobe abscess at that time, the patient's condition not warranting it. Because of the

adhesions of the upper lobe there was little danger of mediastinal flapping; however, the ligatures were all left long and fastened to the chest wall. The wound was closed by muscular and cutaneous suture with drainage anteriorly and large drainage posteriorly with gauze down to the abscess stump. A third small incision was made low down posteriorly to make sure of good drainage by tube. Hemorrhage was slight.

Eight hours post-operative the patient's condition was good; the pulse was 120 and respirations were forty. After that, however, there was rapid deterioration of the heart action with weakness and irregularity, although the rate did not

go higher than 160. There was much cough with expectoration of very foul pus, evidently from the abscess of the upper lobe. Twenty-four hours post-operative because of the progressive cardiac failure, a transfusion of 360 c.c. of citrated blood was made, but she continued to lose ground and a few hours more death occurred.

CASE VII.—*Chronic Bronchiectatic Abscess of Right Upper Lobe Following Tonsillectomy.* Sylvia M., eight and one-half years old, was admitted to the Medical Service of Mount Sinai Hospital on January 23, 1919. Temperature, 105°; pulse, 140; respirations, forty. Nine months before tonsillectomy had been performed in general anaesthesia and about two weeks later there was coughing with foul expectoration and irregular fever. Four weeks before admission the child had spit a little blood and there were occasional night sweats.



FIG. 5.—Case 7. Patient well, showing use of arm.

Physical examination showed the right tonsil absent. In the right lung from the apex to the second rib were signs of cavitation, while there were many fine moist râles over the entire upper lobe. Urine negative. Fingers clubbed. Blood showed 17,600 white cells with ninety-seven per cent. polymorphonuclears, twenty-one lymphocytes and two eosinophiles. Hæmoglobin sixty per cent. Blood-pressure 95-65.

X-ray examination showed dense consolidation of the right upper lobe in the centre of which was a circular cavity an inch in diameter at the level of the second space anteriorly.

On February 17th the chest was punctured with a small trocar and cannula below the diseased part in presumably normal pleura with the idea of admitting air so that a subsequent radiograph would show the character and location of adhesions. This examination was satisfactory and indicated that there were no

general adhesions in the upper part of the chest. The diseased area was much more easily seen than before the air had been admitted.

Operation.—On February 18, 1919, in intrapharyngeal gas and ether anaesthesia by Doctor Branower, a seventh interspace incision was made and carried upward posteriorly parallel with the scapula. Small sections of the sixth and fifth ribs were removed. Rib-spreader exposure. There were a few adhesions at the apex, one of which required ligation. A dense adhesion between the upper and lower lobes posteriorly was also ligated and divided. Other adhesions were broken down digitally. The upper lobe was then removed beyond serial chromicized catgut suture-ligatures. A separate drainage opening was made in the lower part of the chest posteriorly into which a tube was inserted to the dead space above. Through the upper posterior wound a small gauze packing was led down to the carbolized stump and then both wounds were sutured, closing the entire chest—skin and all.

Post-operative Course.—

Immediately after the operation, although the patient's general condition was excellent, 200 c.c. of citrated blood were infused intravenously. Morphine and codein were ordered in sufficient quantities to keep the respirations below thirty-five and tincture of digitalis five mm. was ordered every six hours for two days. The respirations had been sixty immediately after the operation but were reduced by the medication to twenty-six. Reaction temperature to 105° dropped to 101° . Pulse immediately after

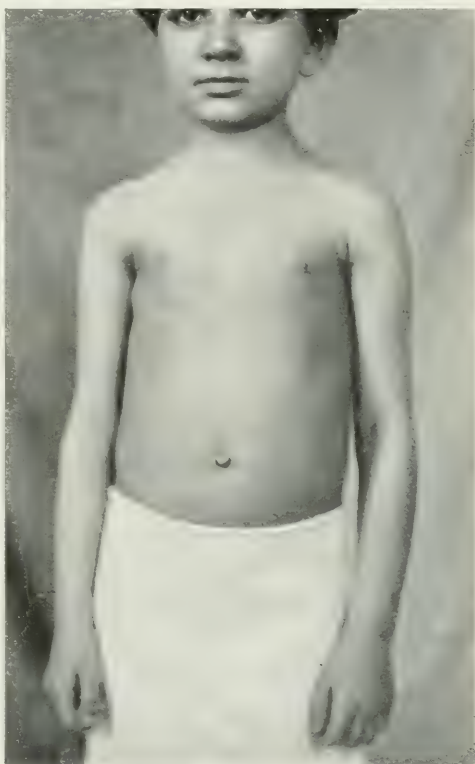


FIG. 6.—Case 7. Patient well, showing symmetry.

operation 160, but in twenty-four hours the rate was 120. Patient's morale excellent.

Forty-eight hours after operation the drainage openings were exposed. There was no great tension within the chest and comparatively little fluid. The lower tube did not drain satisfactorily. The gauze was removed from the upper opening and there escaped several ounces of foul thin fluid. Since the lower drain was unsatisfactory a tube of large calibre was inserted through the posterior part of the upper wound and the foot of the bed was elevated. On March 3rd the temperature began to mount slowly and five days later it reached 104° and there was rapid pulse and general deterioration. X-ray examination was not helpful but retention was suspected, and on withdrawing the lower tube a few drops of thick pus escaped. Therefore in gas and oxygen anaesthesia the adjoining rib was resected and the chest explored with the finger. No pus, however, was

encountered and the tube was replaced. This operation was not followed by relief, but twenty-four hours later there was a sudden discharge of a quantity of pus from the upper wound and the patient's condition became critical. March 19th, after a stormy period, the little girl was considered out of danger. On April 21st she was discharged well, having gained much in weight and with perfect function of the arm. The case has been followed up carefully and recovery seems to have been perfect. (Figs. 3-6.)

CASE VIII.—*Bronchiectatic Lung Abscess—Post-tonsillectomy. Pneumectomy—Death.* Rose F., twelve years old, had her tonsils removed in gas anaesthesia in August, 1918. About two weeks later the usual symptom complex of bronchiectatic lung abscess appeared. I first saw her as a patient on the medical side of Mount Sinai Hospital in February, 1919.

Preoperative Condition.—There was clubbing of the fingers and toes, periods of high fever with remission and much coughing with copious expectoration of foul mucopus. The right lung was much contracted; the right diaphragm was adherent and drawn upward. The progress of this condition was followed up by means of X-ray study, which clearly indicated a steady extension of the disease. (Figs. 7-11.)

On February 28, 1919, I operated; Doctor Branower administered the anaesthesia (gas, oxygen and ether).

Operation.—A long seventh interspace incision with resection of the seventh, sixth and fifth ribs posteriorly. The skin wound was extended vertically to permit of rib sections. There were numerous adhesions to the chest wall, the posterior ones being very dense. The entire right lung was hopelessly diseased and it was removed by the chain ligature method, each part ligated being previously clamped. Toward the end of the operation, on lifting the lung outward, a sudden hemorrhage occurred from a large vein. The opening in the vein was secured with clamps, which were left in place, owing to the patient's desperate condition. Citrated blood transfusion was immediately performed and the wound was partly closed by suture. The patient left the table with a rapid but easily countable pulse, but she died six hours later, apparently from oedema of the opposite lung. The specimen showed extensive suppurative bronchiectasis throughout the greater part of the right lung.

CASE IX.—*Abscess of Lung Following Tonsillectomy—Partial Extirpation and Drainage—Death.* I first saw Mrs. J. P. in the Private Pavilion of Mount Sinai Hospital on March 16, 1919. About five years before she had had her tonsils removed in general anaesthesia and the usual symptoms of lung abscess appeared about two weeks following the operation. There had been a gradual progression of the symptoms with occasional small hæmoptyses, expectoration of about ten ounces of pus per day and pain in the left chest. The abscess was opened about a year following her tonsillectomy in a two-stage operation with resection of the eighth rib posteriorly and suture of the lung to the parietal pleura followed by opening and drainage of an abscess. She was unrelieved.

On my examination I found a frail, little woman, thirty years old, with clubbing of the fingers, fetid breath and signs pointing to consolidation posteriorly in the left chest. The temperature was 100°. The urine was normal. Blood-pressure was 130. The heart action was normal as to strength but was not regular.

X-ray examination by Doctor Wessler demonstrated a shadow, presumably a lung abscess of large size, either in the lower part of the upper lobe or the upper part of the lower lobe.

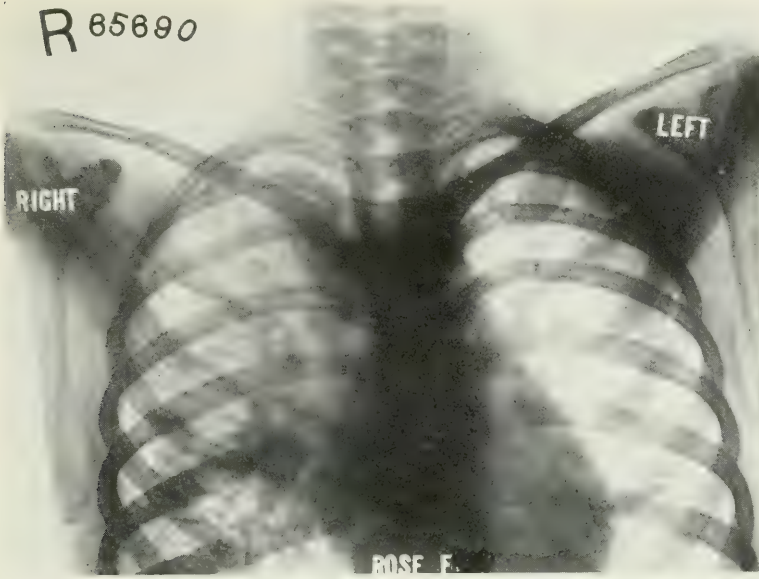


FIG. 7.—Case 8. Rose F. These five pictures taken at intervals during three months show progress of the disease. Operation should have been performed earlier.

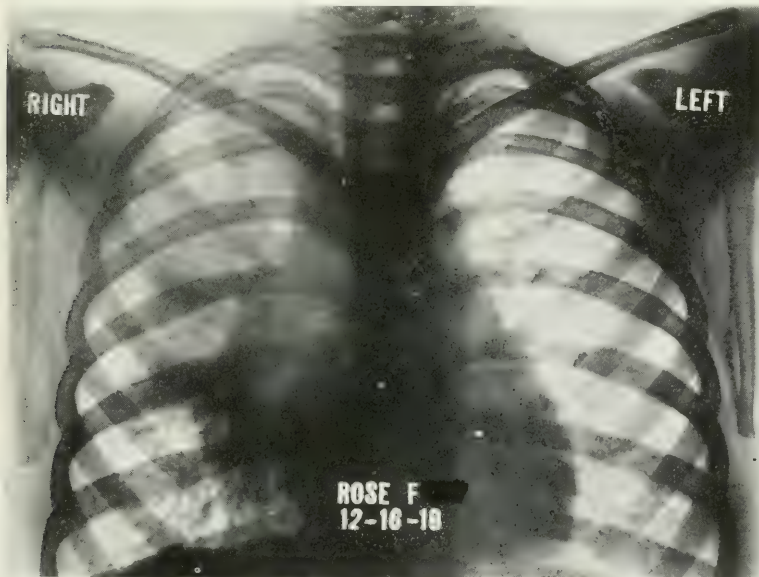


FIG. 8.—See legend on Fig. 7.

Digitalis stimulation was administered for the twenty-four hours before operation. On March 29th I operated, Dr. Martin Ware assisting, anaesthesia by Doctor Branower.

Operation.—An incision was made above the old scar with a long resection of the seventh rib and division of the sixth and fifth ribs posteriorly. There were

numerous adhesions, particularly at the site of the old operation, and they were divided between ligatures. Both lobes were involved posteriorly and the posterior wall of the large abscess, containing putty-like, extremely foul, inspissated pus, was resected. The remainder of the abscess wall was sponged out with carbolic and packed with iodoformized gauze. The wound was closed with pericostal sutures, suture of the muscles and suture of the greater part of the skin. A wet gauze dressing was applied and retained by adhesive strips placed so as not to confine the opposite chest. During the latter part of the operation the patient's blood-pressure fell to seventy-five and immediately more than 400 c.c. of citrated blood were transfused.

Post-operative Course.—The patient's condition at the end of the operation was apparently good; her pulse, however, became weaker in spite of the fact that there was no hemorrhage, and more rapid, and death occurred twelve hours after completion of the operation.

CASE X.—*Bronchiectatic Lung Abscess Following Tonsillectomy—Lobectomy.* M. V., age fourteen, had had her tonsils removed in general anæsthesia in August, 1919. Diphtheria was said to have followed this operation and the patient was treated with antitoxin. About four weeks later there began cough and symptoms of progressive lung suppuration with fever and putrid expectoration. A radiograph by Dr. James A. Miller, to whom she had been taken by her physician, Doctor La Fetra, showed a shadow at about the middle of the right chest which apparently indicated pulmonary suppuration either in the middle lobe or upper part of the lower lobe.

I saw her first on February 12, 1920, at the Park Hospital. I found a well-nourished child who was running a temperature up to 104° and who expectorated large quantities of extremely foul pus.

She entered the Private Pavilion of Mount Sinai on February 19, 1920, where another X-ray picture showed opacity of the lower two-thirds of the chest, completely obliterating the original abscess shadow. Aspiration with large needle was performed on February 20, 1920, with the idea that an empyema existed also. No pus was obtained, however. As the needle was withdrawn, a small quantity of two per cent. lysol solution was injected into the tract to prevent, if possible, infection of the chest wall.

The same day she expectorated an enormous quantity of pus, which was blood-stained, but another X-ray failed to show any change in spite of this emptying.

On February 21, 1920, in gas and oxygen anæsthesia by Doctor Branower, Doctor Aschner assisting, I operated.

Operation.—A long seventh interspace incision was made with resection of a small piece of the posterior part of the seventh rib, and rib-spreader exploration was done. Dense adhesions existed posteriorly between the dark red solidified lower lobe and the chest wall. The middle and upper lobes looked normal, but the upper lobe was adherent posteriorly. There was no adhesion between the lower lobe and the diaphragm. With the intention of performing a lobectomy at another sitting, gauze packings were placed between the upper lobe and the chest wall to cause adhesions here and a piece of rubber dam was laid between the middle and lower lobes to prevent adhesions in this part. The wound was then closed with two kangaroo-tendon pericostal sutures and two layers of chromicized catgut muscle sutures, completely covering in the gauze and making the chest airtight. The skin edges were approximated—but not united—with three silkworm-gut stitches.

Post-operative Course First Step.—Forty-eight hours later the gauze packings were removed and about thirty ounces of bloody serum escaped. The wound was then firmly closed with broad adhesive strips. The pulse was still rapid (150),

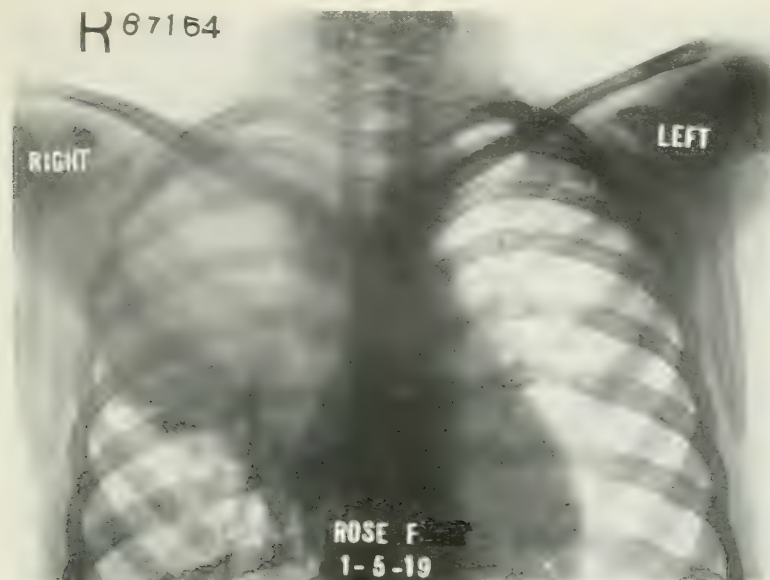


FIG. 9.—See legend on Fig. 7.

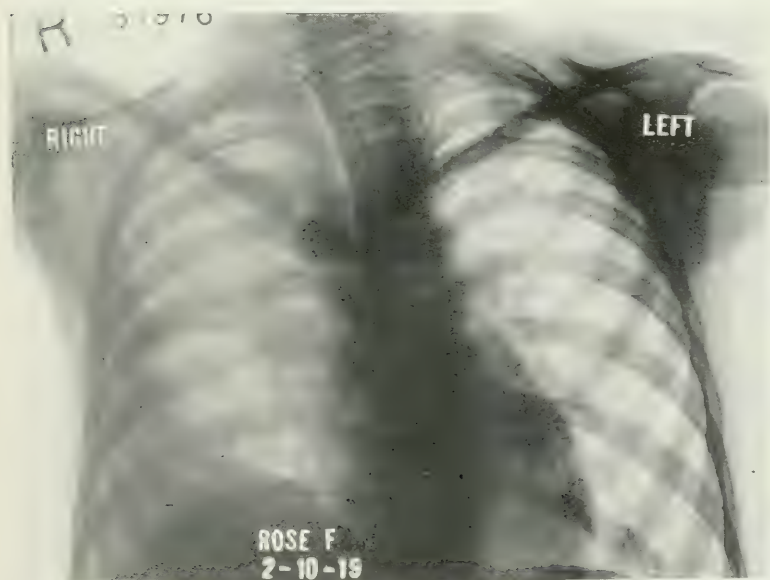


FIG. 10.—See legend on Fig. 7.

but the conditions generally looked not unfavorable. On February 28th, one week after the first operation, the lobectomy was performed. There had been digitalis therapy and the pulse was between 140 and 150, but of fair quality. The temperature had ranged between 101° and 104°. One hour before the operation eight mm. of Magendie's solution were given hypodermatically. Doctor Branower again anæsthetized with a little ether, followed by nitrous oxide and oxygen,

and the intrapharyngeal method was used. Doctor Aschner assisted at the wound.

Operation.—An incision almost to the top of the shoulder was made from the posterior angle of the old wound. The next three upper ribs were divided posteriorly and most of the seventh rib was removed with its periosteum. There was a little annoying bleeding from one intercostal vessel which could only be properly secured after the rib-spreader had been put in. It was now seen that the upper and middle lobes were nicely adherent to the chest wall and were of good normal color. The space in which the rubber dam had been placed was filled with opalescent serum and the adjacent lung surface looked almost like the walls of a pyogenic cavity. The lower lobe had become firmly adherent to the diaphragm, some adhesions having to be cut between ligatures. Where the lower lobe was adherent to the chest wall behind, it had to be peeled away, but the resulting hemorrhage was slight. Orientation up to this time had been difficult.

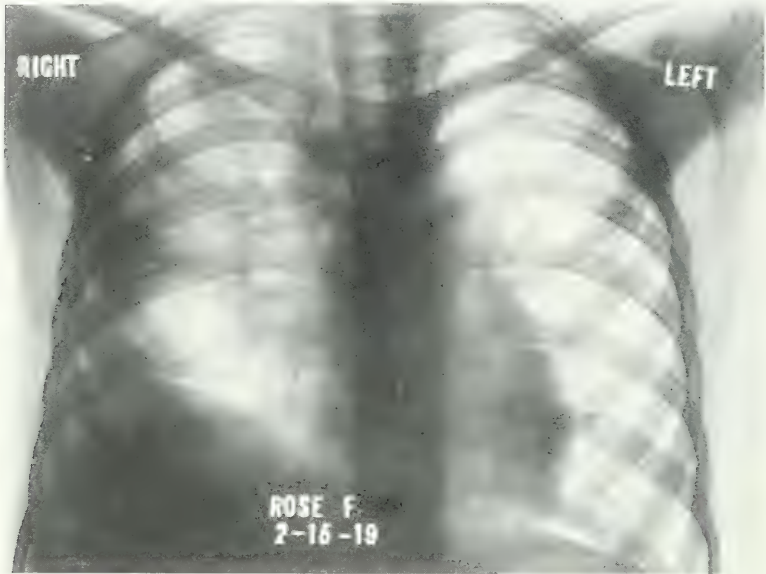


FIG. 11.—See legend on Fig. 7.

A few adhesions between the upper and lower lobes were divided between ligatures. The pedicle was now transfixed by numerous silk ligatures carried on hæmostatic needles, none of which took too large a bite. All ligatures were of No. 3 twisted silk, except one which was not finally counted upon but which encircled the greater part of the pedicle. This silk was of the heavy braided variety, about No. 12. As each ligature was tied the lung beyond it was cut away. At one point a large vessel bled for a second or two, but was quickly secured with a heavy clamp. Ligatures were placed behind this clamp and also distal to it before it was removed. The lobe was at last cut away, the stump carbolized and all ligatures were carried out of the posterior wound, which had been enlarged by the removal of about an inch of the anterior portion of two of the divided ribs. The stump was covered by iodoformed gauze which was led out of the chest in one bunch. An intercostal incision was made low down in the axillary line through which a drainage tube was drawn for drainage at a low level. The muscular parts were sutured, closing the chest, and one pericostal suture of chromicized catgut was also put in, although it could not draw the ribs

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together because of the long resection of the seventh rib. The skin was left open, a dry dressing put on and held in place by adhesive plaster, not encircling the chest. The immediate shock was severe on the table; the pulse disappeared, but the transfusion of 1000 c.c. of citrated blood by Doctor Ottenberg, who was present for the occasion, brought back the pulse and reduced the shock.

Post-operative Course.—At the first dressing two days post-operative, the wound was found to be clean. The skin packings were removed, and after iodization the skin edges were drawn together with adhesive plaster. The deep packings were not disturbed. The pulse was still almost 150 but of good quality. At the time of the transfusion some citrated blood got into the tissues of the right arm and there was a rather sharp reaction with considerable painful swelling as far as the shoulder, but under pure alcohol dressings this subsided.



FIG. 12.—Case 10. Miss M. V. Taken three weeks before operation. Shows right lower lobe post-tonsillectomy bronchiectasis.

All the ligatures except the large transfixion suture came away between the eighth and tenth day following operation, leaving the bronchi open. There was the usual foul gangrenous exudate in a large part of the wound and also in the pleura. Oxygen in a continuous fine stream directly from the tank was passed through the chest for twenty-four hours in order to combat anaërobic infection and then the whole cavity was lightly packed with iodoformized gauze. In a few days all odor had disappeared. The heavy silk ligature became very annoying, for it refused to come away, and eventually I had to cut it off in the depths of the wound, illuminating the parts with a flashlight. About April 5th I attempted to use Dakin's solution very cautiously, trying to avoid the bronchial openings. For about three days it was possible to do this. Then, however, there was a severe attack of coughing during the injection, and, although no more Dakin's solution was used, the cough and even a little expectoration, were annoying for a few days.

Two months after the operation the patient was up and about, going out for drives and nearly well, although a minute opening still persisted. She showed

the usual great sensitiveness to exertion, even slight exercise being followed by a temperature as high as 101° , when without exercise the temperature remained normal. She left the hospital on May 1, 1920, and has remained perfectly well, exercising, and, in fact, doing fancy dancing.

CASE XI.—*Suppurative Pneumonitis Following Tonsillectomy—Pneumectomy—Death.* Gertrude K., Hospital No. 201,642, eight years old, entered Mount Sinai Hospital on May 27, 1920, with a temperature of 103.8° , pulse of 142 and respirations thirty-eight. Eight months before she had had measles and three weeks before her tonsils were removed in ether anæsthesia because of frequent attacks of sore throat.

Physical examination showed a very ill, poorly nourished, rapidly breathing child, the tongue coated, the left chest expansion limited, fremitus and resonance

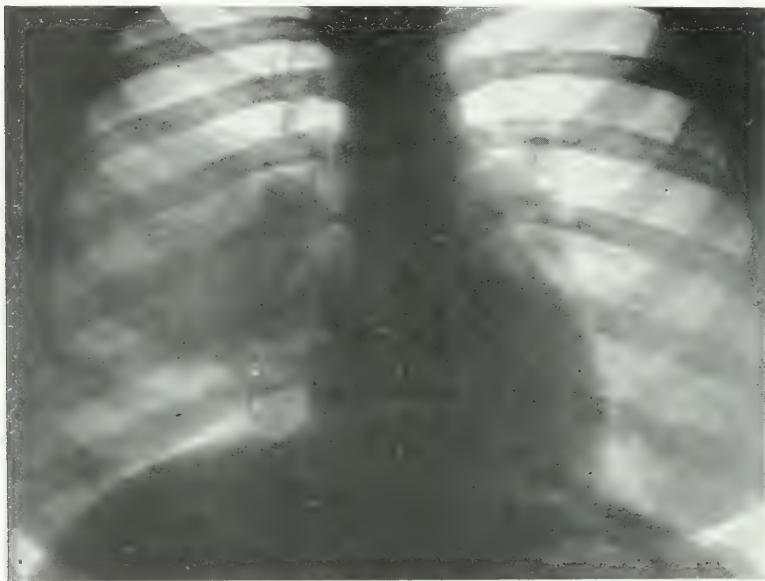


FIG. 13.—Case 10. Two weeks later. Great extension.

diminished over left chest, and a few râles, which were cleared by coughing. The pulse was regular but rapid. Urine negative.

The X-ray picture showed an infiltration of the left lower lobe from the seventh interspace to the base, indicating apparently a pneumonic process. No cavities were shown. The child was kept under observation with occasional days of improvement until on June 5th she complained of pain over the region of the apex of the heart, and another X-ray picture now taken showed a dense shadow as of fluid but without displacement of the heart. It was thought that this fluid might be somewhere encapsulated, and it was for this reason that the heart was not displaced. Believing that a lung abscess had perforated, causing some form of empyema, a major intercostal thoracotomy in ether anæsthesia was done on June 7, 1920, the seventh interspace being the location selected. Just previous to entering the chest, and after the skin and muscles had been incised, aspiration was done with a fine needle and hypodermic syringe and pus was withdrawn. After opening the chest, however, no pus was found, but a bluish-red infiltrated left lower lobe. The needle had entered the lung, and even from this tiny

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puncture pus exuded, illustrating how easy it is to cause empyema even by the most careful aspiration. An opening was made in the lower part of the chest for drainage and a tube inserted, using the hand within thorax as a guide. A gauze sponge dipped in iodine was roughly wiped over the upper lobe and upper parietal pleura so as to make adhesions here previous to the second-stage lobectomy.

Post-operative Course.—No empyema developed, although there was a little purulent discharge from the drainage wound itself. There was some relief judging by the diminished cough and the general comfort of the patient, but her pulse and temperature remained about the same, the pulse running to about 130 and the temperature to $103\frac{1}{2}^{\circ}$. The thoracotomy wound, the skin of which had been left open, began to granulate. This case was obviously a bad risk, but recovery without radical operation was considered practically impossible. Therefore, on June 17th, Dr. Harry Goldman anæsthetizing and Dr. Harold Neuhof



FIG. 14.—Case 10. Day before operation. See history.

assisting at the wound, the entire left lung was extirpated. In separating the lobes pus exuded from the upper as well as the lower lobe. The recent adhesions were quickly broken down and the pedicle ligated with six or seven transfixion sutures of strong twisted silk. Generous stumps were left. Loss of blood slight. Considerable pus appeared at the mouth during the operation and the passages were kept as clear as possible by the use of intermittent suction. The wound was closed with three pericostal sutures and a number of muscle sutures of chromicized catgut. Skin left open. Time of operation twenty-seven minutes. Two hundred c.c. of citrated blood were transfused during the operation by Dr. Ira Cohen. Condition at the end of operation excellent and the patient perfectly conscious before leaving the operating room. The respirations were about forty but without dyspnoea and the pulse of good quality, rate 140. The lack of respiratory embarrassment was explained by the fact that the solidified lung was not functioning before operation. Although the patient reacted well, 90 c.c. of citrated blood were put in the following day.

First dressing forty hours after operation. There was a considerable quantity of serum which escaped when the tube which had been previously clamped was freed.

The expected anaërobic infection appeared but in an unusually malignant form, septic absorption causing diarrhœa with rapid emaciation. A week after operation I was distinctly hopeful, the odor became less offensive and the pulse remained strong. Four days after, however, on account of her diarrhœa and the necessary limitation of food, another sodium citrate transfusion had to be done, this time by Doctor Kaliski, who put in 300 c.c. The hæmoglobin, in spite of the diarrhœa, had dropped to thirty-five per cent. A chill and temperature to 106° followed this procedure, but the reaction subsided, and again there was general improvement. Dr. Herman Schwarz, Associate Pediatrist to the hospital, superintended the diet, but in spite of everything the looseness of the

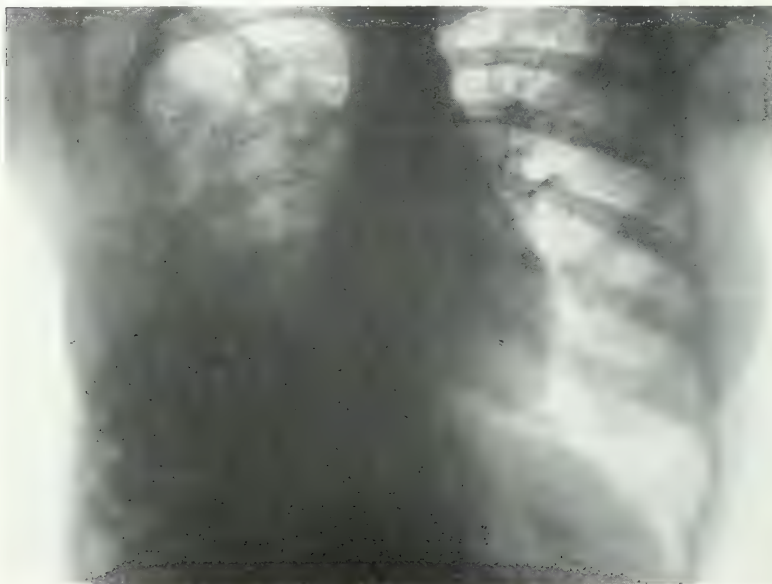


FIG. 15.—Case 10. About four months after operation. Dense shadow means recent scar tissue and thick pleura. Compare with Fig. 16.

bowels continued with as many as thirteen movements a day. The first bronchial fistula appeared about this time. Thirteen days after operation a severe hemorrhage occurred which ceased, however, spontaneously. Careful examination of the chest did not show the source of bleeding. Again Doctor Kaliski transfused with 300 c.c. of blood. About midnight, at the end of the thirteenth day, after another hemorrhage, which had also ceased spontaneously, I examined the wound and found traces of old clotting around the pedicle. While I was examining this a hemorrhage occurred from which she died in a few seconds.

This is the first and only time that I have seen hemorrhage from the pedicle. It undoubtedly occurred from destructive infection of the wall of an important vessel, probably the pulmonary artery, not from slipping of a ligature, for the ligatures were off by this time.

CASE XII.—*Post-tonsillectomy Lung Abscess—Empyema—Thoracotomy and*

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Drainage. Abraham G., eight years old, entered Mount Sinai on May 18, 1920, with high fever—103 degrees—and all the signs of acute suppurative lung infection which had followed tonsillectomy three weeks before. Fever, cough, foul sputum and pain in left chest had appeared a week after the operation. Physical signs of left upper lobe pneumonia. Double cardiac murmur at apex. White blood-cells 4000, polymorphonuclears eighty-nine per cent. X-ray examination showed left lung dense from apex to base. May 22nd, bronchoscopy, by Doctor Yankauer, showed acute localized bronchitis, possibly causing obstruction of the left upper lobe bronchus.

May 27, 1920, Doctor Aschner performed a seventh interspace thoracotomy, evacuating foul, thick pus. Some days later I performed major exploratory thoracotomy, encountered a bronchial fistula with such dense lung and with such firm adhesions to the mediastinum that nothing further could be done. However, there was a gradual improvement, and all wounds healed. He had several bad

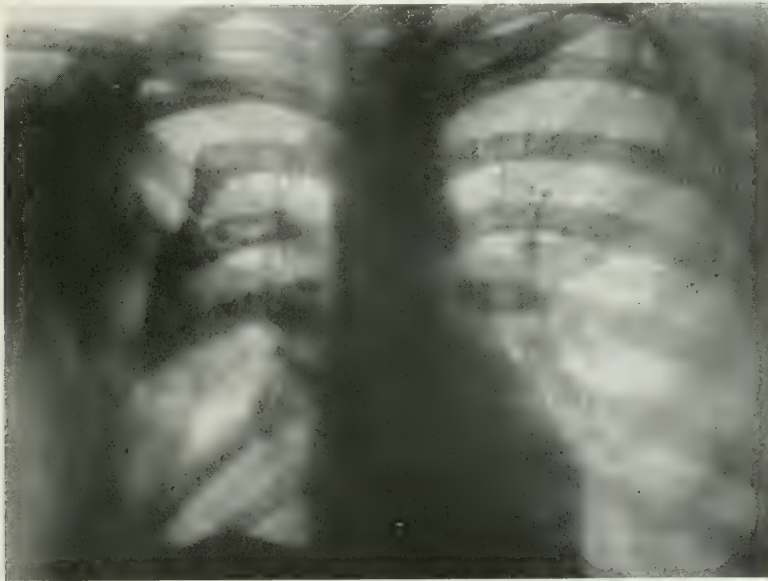


FIG. 16.—Case 10. One and one-half years after operation. Patient remains entirely well. Perfect function. Note bony bridge between three divided ribs. No pneumothorax.

relapses later and at this writing is just recovering with a bronchial fistula from a severe exacerbation.

CASE XIII.—*Bronchiectatic Lung Abscess—Attempted Extirpation—Death.* (Abstract of history reported in the ANNALS OF SURGERY, July, 1916.) Jacob S., 36 years old, Hospital No. 146,288, was admitted to Mount Sinai Hospital on June 2, 1914. Twenty-eight years before he had had pneumonia from which he completely recovered. Two years before he had been operated upon for abscess of the right lung. The present illness began with pain in the right chest, copious expectoration of foul sputum, severe night sweats and vomiting. These symptoms had existed for more than six years and had not been relieved by his operation of two years before when sections of the sixth, seventh and eighth ribs had been removed, evidently with the idea of collapsing the diseased part of the lung.

Pre-operative Condition.—Physical examination showed signs of cavity in the chest, clubbed fingers, cyanosis and rapid pulse. Urine contained a trace of albumin and a few white blood-cells. On admission his temperature was 101.2°, his pulse ninety-six and the respirations twenty-four. The temperature depended largely upon the patient's ability to empty the abscess by coughing. At times he ejected as much as twenty ounces of sputum in a single day.

X-ray examination showed an extensive involvement of the right lower lobe and a portion of the upper lobe.

Bronchoscopy was performed on June 8, 1914, by Doctor Yankauer, and the abscess pretty well emptied, with reduction of temperature and some improvement subjectively. No foreign body was found, but the bronchi were seen to be enormously dilated.

Operation.—On June 11, 1914, in intratracheal anaesthesia with ether an attempt was made to extirpate the diseased part of the lung. A long incision in the sixth interspace was made and the rib-spreader put in. Dense adhesions were encountered everywhere, so it was with great difficulty that I finally succeeded in entering the free pleural cavity, even at this high level. An attempt was made to isolate the diseased part by peeling it away from the parietes. This proved to be impossible, and then an attempt was made to isolate the diseased portion by means of ligation through the apparently healthy lung. During this process, however, although he had not lost much blood and although the lung was well fixed by adhesions which prevented flapping of the diaphragm, the patient suddenly collapsed and the operation had to be stopped.

FIG. 17.—Case 10. Wounds healed after right lower lobectomy. Function of arm perfect. Patient perfectly well.

We had taken the precaution to practice blood segregation and the ligatures of the thighs were now cut away. The patient also received twenty ounces of saline solution intravenously with a few drops of adrenalin. He revived, the pulse improved and he was able to respond to questions. About an hour and a half after the operation, however, he died. No autopsy was permitted.

I think it quite possible that oozing from the abscess cavity which had been entered during the operation was instrumental in his final taking off. I was at work over another patient when word came that this patient was bleeding. My house surgeon had at once reopened the wound and packed the abscess cavity from which he stated the bleeding came. This case exemplifies the importance of recognizing an inoperable case after the chest is opened. Had we then satisfied

ourselves with rib resection directly over the abscess, as found on thoracotomy and exploration, with evacuation and packing of the cavity, the operative death might perhaps have been avoided though the patient would not have been cured.

CASE XIV.—*Bronchiectatic Lung Abscess—Resection of Middle Lobe and Part of Two Adjoining Lobes.* This case has been reported in the ANNALS OF SURGERY for July, 1916. The following is a brief abstract:

David J., Hospital No. 150,495, sixteen years old, was admitted to Mount Sinai Hospital on December 2, 1914. His temperature was 99°, the pulse was 90 and respirations 22. Cause of disease unknown. Cough and expectoration had begun six months before and had steadily increased until large quantities of greenish, offensive mucopus were expelled. There was pain in the right chest and a loss of fifteen pounds in weight. The urine was negative. Leucocytosis present; no tubercle bacilli found. The Wassermann blood examination was negative.

Bronchoscopy by Doctor Yankauer showed a dilated secondary bronchus on the right side from the middle lobe, but a lower branch was also discharging pus.

X-ray Examination.—The X-ray showed a dense shadow the size of an adult palm in longitudinal position roughly in the line of the fissure. The diagnosis before operation was bronchiectatic abscess.

Patient transferred to me by Doctor Manges.

Operation.—On December 28, 1914, in intratracheal anesthesia by Doctor Branower, a nine-inch incision was made in the sixth interspace. There were general adhesions in the entire chest, so that although anatomically within the pleura, there was no free cavity. The middle lobe—the principal site of the disease—was resected beyond chromicized catgut ligatures and removed. The remaining part of the indurated tissues in the contiguous parts of the upper and lower lobes was surrounded by transfixing ligatures of chromicized catgut through healthy lung. The part of the lung strangulated by these ligatures was not removed but was left to slough off. A piece of the seventh rib was now resected for drainage and the entire cavity packed with gauze which emerged at the drainage opening. The remainder of the wound was closed in two layers without pericostal suture. Loss of blood was slight.

Post-operative Course.—The pulse-rate rose to 140 and two days later the temperature was 103°. Expectoration about two ounces in twenty-four hours



FIG. 18.—Case 18. Fannie B. Patient well after extirpation of left lower and part of upper lobes. Note symmetry of body.

and no longer foul. Cough and expectoration rapidly diminished until on June 22nd they were almost absent. There then developed an encapsulated empyema on the mediastinal side which was opened in local anæsthesia on February 1st. The subsequent progress of the case was satisfactory, although far from steady, with little relapsing attacks of empyema of small size. He was not discharged until May 3, 1915. The wound was then soundly healed, and after a few weeks in the convalescent home he was apparently perfectly well. He remained well until April 29, 1916, when after undue exertion in playing baseball an abscess in the scar developed which communicated with the chest. It was incised under local anæsthesia and quickly healed. I kept track of this boy

for two years afterward and he remained well, although subject to colds with slight cough and expectoration. I then lost track of him.

CASE XV.—*Chronic Lung Abscess—Extirpation of Right Lower Lobe—Death.* This case has been reported in the ANNALS OF SURGERY for July, 1916. A brief extract follows:

Jacob K., Hospital No. 155,433, patient of Dr. Geo. Mannheimer, fifty-three years old, was admitted on June 16, 1915. The patient had been operated upon for cholecystitis about a year before and had been operated upon again on account of a jaundice in February, 1915. Soon after this he began to cough and the usual symptoms of lung abscess developed with loss of twelve pounds in three months. The patient was pale and emaciated. The lung was emphysematous anteriorly. On the right from the angle of the scapula to the base extending to the axilla râles and flatness. Clubbing of fingers. Urine acid; trace of albumin.



FIG. 19.—Case 18. Illustrating function of arm

X-ray examination showed a dense shadow which was interpreted as infiltration of the upper part of the right lower lobe.

Operation.—On June 17, 1915, in intrapharyngeal anæsthesia by Doctor Branower, I made a long seventh interspace incision. Posterior part of lower lobe densely infiltrated and dark in color. Infiltration extended also a little way into the middle lobe. The right lower lobe was freed to the hilum and the pedicle being small it was cut off beyond two heavy silk mass suture ligatures. Four bronchi were ligated separately beyond the ligatures after the specimen had been removed. The operation was easy and quick. The stump of the lung was not fixed to the chest wall. The wound was closed in layer sutures and three drainage tubes were left just within the thorax posteriorly.

Post-operative Course.—The patient left the table in good condition with pulse of about 100. In less than an hour, however, his respiration became gasping, his pulse feeble, and he died in a few moments. Probably his death was due to mediastinal flapping.

CASE XVI.—*Suppurative Bronchiectasis (Post-pneumonic)—Lobectomy Right Lower Lobe—Death.* (Abstract from report in *ANNALS OF SURGERY*, July, 1916.) Joseph S., Hospital No. 160,179, twenty-five years old, was admitted to Mount Sinai Hospital, December 22, 1915. Temperature, pulse and respirations normal. He had had the usual diseases of childhood and six years before admission had had pneumonia and pleurisy for six weeks. The following year he remained well, but then there began cough with profuse greenish expectoration.

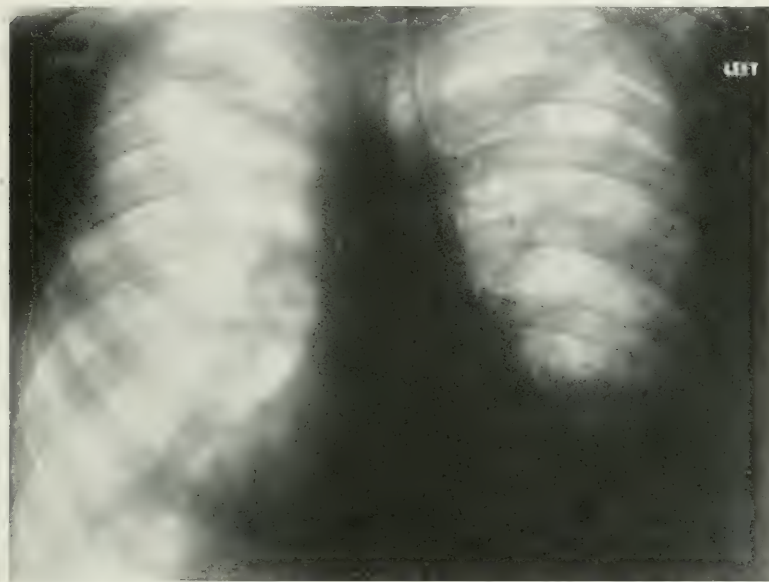


FIG. 20.—Case 21, J. M. W. Preoperative. This is a case of transposition of the viscera. Left lower lobe bronchiectasis. The diagonal right shadow from midchest to base parallel with heart shadow was not considered pathological by the röntgenologists. It suggests to the writer peribronchial congestion.

The symptoms subsided in summer and became aggravated in winter. This went on for about four years, but two years before admission to the hospital the cough and expectoration became continuous, and it was thought that he had tuberculosis until he became the patient of Dr. George Mannheimer, who made the diagnosis of bronchiectasis. There was no fever and no other constitutional sign of sepsis. On admission his condition was good. The right chest posteriorly showed dullness from the spine of the scapula to the base with increased voice and breathing, with sibilant and sonorous râles. On the left side there were similar signs. No tubercle bacilli in the sputum, the total amount of which was about eight ounces in twenty-four hours, foul and purulent in character. The urine was normal. For several years the man had been unable to work and became so miserable and depressed that he begged for relief at any risk. The X-ray showed a shadow occupying the position of the right lower lobe with adhesions between the lung and chest wall and between the lung and diaphragm. The left lower lobe also was not above suspicion.

December 27, 1915, I operated. Narcosis induced by ether was continued with nitrous oxide and oxygen administered by the intrapharyngeal method (Branower).

Operation.—A long eighth interspace incision was made, but it was also necessary to remove the greater part of the eighth rib, to divide the seventh also, just in front of the angle and again near the cartilage, and with the rib-spreader plenty of room was obtained. At the first inspection the case looked inoperable on account of the presence of dense, tough, fibrous adhesions to the chest wall, to the diaphragm and between the lobes. Indeed, in the light of subsequent events this case should probably have been regarded as inoperable. The lobe, however, was finally mobilized, but at the expenditure of much time.

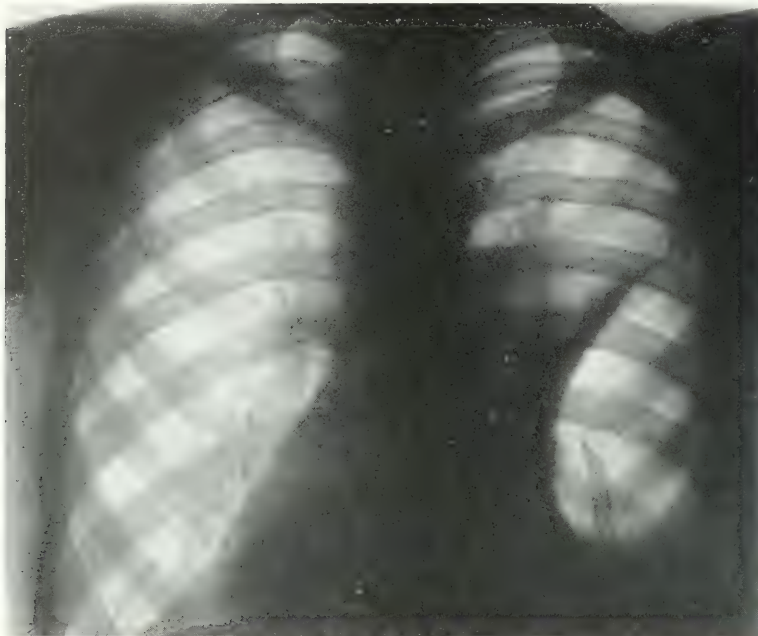


FIG. 21.—Case 21, during healing. Note pneumothorax and drainage tube. The pneumothorax was later replaced by lung tissue. (See Fig. 23.)

It was removed after crushing the pedicle with a special clamp devised by Doctor Yankauer at my suggestion. The pedicle was crushed to a ribbon and was then ligated with fine ligatures of chromicized catgut and the lobe was cut away. Immediate section of the specimen showed great infiltration and numerous greatly dilated bronchi. During the operation possibly eight ounces of blood were lost. The entire right diaphragmatic surface was left raw. All bleeding had apparently ceased at the end of the operation which had lasted nearly one and one-half hours. The ribs were approximated with pericostal chromicized catgut sutures and the mediastinum was steadied with the help of a large suture through the pedicle fastened to the chest wall. At the end of the operation the pulse was 140 but of good quality and the respirations twenty. There was, however, great shock and he was given twenty ounces of saline solution subcutaneously.

Post-operative Course.—Two hours later the pulse rose to 168 and there was cough with slight blood-tinged sputum. It was necessary to give him an intravenous saline infusion three and one-half hours after the operation and the next day he received 300 c.c. of citrated blood. His condition apparently im-

proved and I had great hopes of his recovery, but thirty-six hours after the operation he became unconscious, the right pupil dilated and the left apparently contracted. A lumbar puncture yielded clear fluid under increased pressure. The temperature rose to $107\frac{1}{2}^{\circ}$, the pulse which had remained good suddenly became weak and he died forty hours post-operative.

CASE XVII.—*Suppurative Bronchiectasis (Chronic)—First-stage Contemplated Lobectomy—Death.* Charles G., Hospital No. 168,304, age thirty-seven, had been operated upon for gastric ulcer in November, 1916, and appeared to make a complete recovery. He entered Mount Sinai Hospital on November 22, 1916, with a history of having cough and expectoration for six months. The discharge was thick, yellowish and foul. It was worse in the morning and frequently



FIG. 22.—Case 21, about 3 months after left lower lobe resection.

accompanied by vomiting. No hæmoptyses. He finally became bedridden and the sputum became blood-stained.

On admission to Mount Sinai the lungs showed crepitating râles all over the right side with dullness toward the base on the right, dullness posteriorly from the angle of the scapula and flatness at the extreme base. There were no elastic fibres and no tubercle bacilli in the sputum. Pulse sixty-four; respirations twenty, and while the temperature was ninety-nine and one-half degrees on admission, there was a history during a sojourn at Bellevue of exacerbation with fever running to 104.

Bronchoscopy.—On November 27, 1916, bronchoscopy by Doctor Yankauer. No pus was seen in the left bronchus but the right was dilated and contained pus from the lower lobe. No pus from the middle lobe. Entrance to upper lobe bronchus swollen and a small quantity of pus seen coming from it.

X-ray.—The X-ray picture showed disease of the right lower and possibly middle lobes toward the hilum, the interpretation being suppurative bronchiectasis.

On December 7, 1916, in general anaesthesia I operated.

Procedure.—I made a long eighth interspace incision and divided the seventh and eighth ribs posteriorly to permit good exposure. Most of the disease was

found near the hilum in the lower and middle lobes; the upper lobe was adherent to the chest wall by a few tender strands. It was rubbed briskly with gauze, the costal pleura was also rubbed with gauze and then painted with tincture of iodine. The chest was then completely closed and the lungs during closure were kept inflated by Doctor Branower with the aid of the intrapharyngeal insufflation.

Post-operative Note.—This patient never came to his second stage because he died apparently of septic pneumonia four days after operation. Unfortunately there was no autopsy.

CASE XVIII.—*Suppurative Bronchiectasis—Left Lower Lobectomy and Partial Resection of Upper Lobe.* Fannie B., Hospital No. 196,598, sixteen years old,

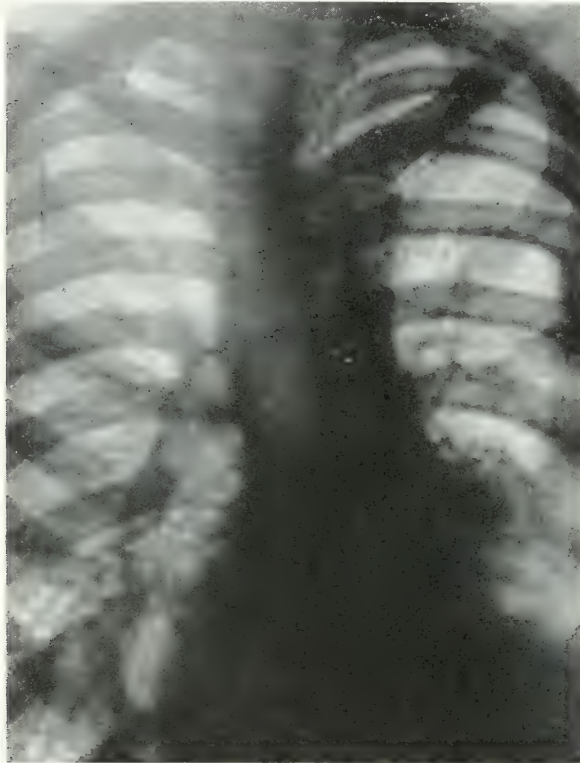


FIG. 23.—Case 21. One year after lobe resection. Patient still has some expectoration and still has nasal sinusitis. Otherwise well.

was admitted to the Medical Service at Mount Sinai on November 17, 1919, in the care of Doctor Celler. At five and one-half years of age her tonsils had been removed and she had remained well until one year before admission when there began pain in the left chest and expectoration of mucoid, greenish material, increasing in quantity; then there was a gradual recession until on admission the daily expectoration amounted to about two ounces of slightly fetid sputum. Her temperature was 102.2° , the pulse was 124 and the respirations were 24. Her general condition was excellent and there was no clubbing of the fingers. There was dullness from the scapula to the base of

the left lung with diminished breathing and crackling râles.

Pathological examination of the blood showed 11,000 white blood-cells, seventy-five per cent. polymorphonuclears and twenty-four per cent. lymphocytes.

The X-ray showed the heart drawn to the left and a shadow occupying the lower part of the chest from the base of the heart exteriorly to the ninth rib exteriorly.

Bronchoscopy by Doctor Yankauer demonstrated pus from the left lower bronchus.

I operated on December 4, 1919, in intrapharyngeal ether administered by

RESECTION OF THE LUNG FOR SUPPURATIVE INFECTIONS

Dr. J. Lawrence Jones of the House Staff, assisted by Doctor Aschner. Doctor Neuhoof acted as first assistant at the wound.

Operation.—A long eighth interspace incision was made and the rib-spreader inserted. The entire lower lobe was dark in color and greatly contracted. A few adhesions held it firmly to the diaphragm and to the upper lobe. The lower anterior edge of the upper lobe was also dark and sharply defined from the normal lung. The diseased lung was soft, contained air, and a number of nodules were felt. After enlarging the wound posteriorly, the eighth, seventh, sixth and fifth ribs were divided and part of the eighth rib was resected. Extirpation of the lower lobe was now performed after division of the adhesions, and a resection of the diseased part of the upper lobe about two and one-half inches long and one inch wide was made. The stump of the lower lobe was carbolized. An incision was made in the lower part of the chest for drainage, and after drawing the ribs

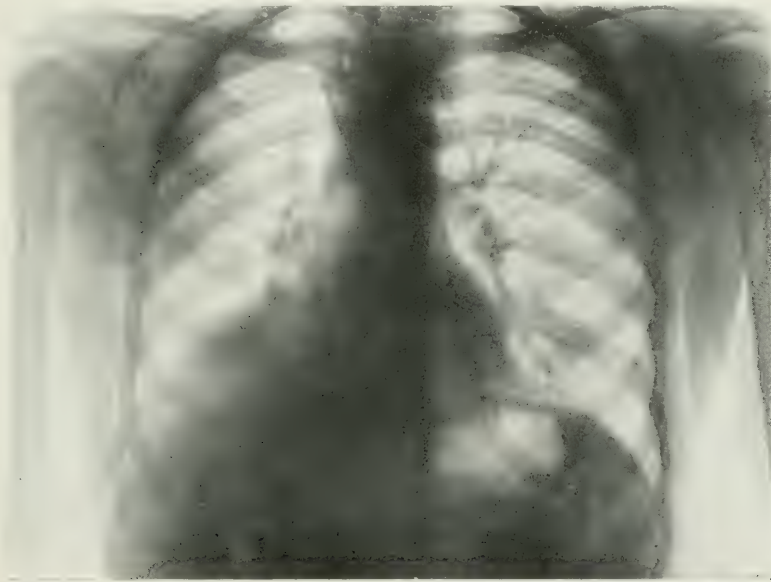


FIG. 24.—Case 29. Gussie P. Congenital bronchiectasis, right lower lobe, later infected.
Before operation.

together the wound was sutured by pericostal chromicized catgut sutures. The ligatures from the stump were drawn out of the posterior wound and fastened there at slight tension to steady the mediastinum. All ligatures and also the end of a piece of gauze which had been carried to the stump were buried beneath the skin suture so as to make the chest airtight. The distal end of the tube from the drainage wound was now submerged beneath water and the lung was distended until all bubbles ceased to appear; then the tube was clamped. The wound was dressed and after the patient was put to bed the end of the drainage tube was carried under weak lysol solution and the clamp removed according to Kenyon's method for drainage.

Post-operative Course.—The operation was well borne, the pulse was steady throughout, no blood appeared at the mouth and the patient's color was good. The reaction temperature never exceeded 101 degrees. Thirty-six hours post-operative the first dressing was done; there was comparatively little discharge. The sutures over the buried gauze and ligatures were removed. The patient, however, was coughing as much as six ounces of thick, tenacious mucus. This diminished under guaiacol carbonate medication.

On the eighth day after operation the ligatures came away spontaneously. The same day suddenly the respirations rose to forty and became shallow. The patient's color became ashen (not cyanotic) and the appearance anxious. I was out of town for the day and Doctor Wessler discovered a pneumothorax pushing the heart and mediastinum far to the right. The pulse remained good, however, not rising higher than 120. The following morning I aspirated about 600 c.c. of air through an anterior puncture in the third interspace. The X-ray showed fluid, but the level could not be determined since the patient was not examined in the erect position. (In this case it is my theory that the pneumothorax was due to the rapid absorption of the ligatures around the stump of the resected upper lobe which was on the mesial side and that the patient's violent coughing had resulted in air leakage from this stump through the smaller air passages. Either unchromicized gut was given me, although it was stained the

red color of the Mount Sinai chromicized catgut, or the gut had been insufficiently chromicized, for this gut ordinarily remains unabsorbed six weeks.)

On December 14th, after fluoroscopy by Doctor Wessler and myself, in which a fluid level was clearly demonstrated crossing the median line, the patient was taken to the operating room and without anaesthesia a block-tin catheter bent to the curve of the chest was passed through the anterior adhesions into the pneumothorax. The dilated opening evacuated air and about a pint of perfectly clear yellow fluid. After this, except for occasional

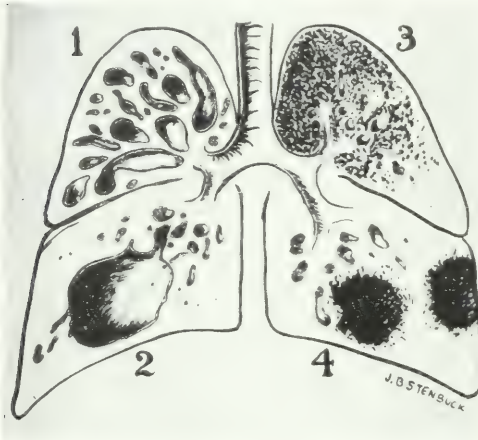


FIG. 25.—Diagram showing four types of pulmonary suppuration. 1. Bronchiectasis. 2. Bronchiectatic abscess. 3. Suppurative pneumonitis. 4. Extrabronchial abscess.

setbacks due to retention, there was continued improvement. The upper wound closed, but a long tube was kept in the lower opening because of sacculation in the chest. She was discharged a few weeks later, apparently well.

About April 24, 1920, the patient was readmitted to Mount Sinai with fever, cough and muco-purulent expectoration. In the upper wound behind the scapula was found a small area of softening where it was believed an empyema might break through. The X-ray showed a small fluid level in the region of the upper wound. A day or two later a sliver of rib was extruded from this point. There was no connection with the thoracic cavity.

On April 28th, with the patient sitting up in bed, I put an aspirating needle through the cicatrix behind the scapula into the chest with the idea of finding the pus. Instantly there was a sharp hæmoptysis and on withdrawing the needle a stream of blood, two or three drams in all, ran down the patient's back. She strangled, became cyanotic, gasped for breath, the pulse became extremely rapid, there was perspiration and for a moment it looked as if a fatal accident had occurred. About three or four ounces of blood were expectorated. The bleeding stopped at once after the inhalation of amyl nitrite and ligation of the thighs. Next day, with the exception of the expectoration of brownish muco-purulent sputum, the patient had returned to the normal state. Two days after

the hæmoptysis the X-ray showed the left chest almost filled by lung, only a pneumothorax at the apex remaining. The temperature had dropped and while there was still slight streaking of the sputum the patient was in excellent condition. Finally, all symptoms disappeared and the patient was discharged apparently well after a residence in the hospital of about three weeks. She probably had a pneumonia which may not have been connected with her old trouble. The last report in October, 1920, was that "she is well and has gained many pounds." (Figs. 18 and 19.)

Bronchiectasis: Left lower lobe one stage lobectomy.

CASE XIX.—Mrs. A. M., twenty-six years old, was referred to me by Doctor Bertram Waters. First signs of the disease appeared four years before I saw her. No actual assignable cause for her condition excepting a history of



FIG. 26.—Bronchiectasis, cross section of bronchus, showing thick infiltrated papillary mucous lining.

frequent colds with bronchitis. Influenza in December, 1918, from which she never entirely recovered. Tuberculosis was suspected but tubercle bacilli were never found.

Pre-operative Course.—Left lower lobe showed definite signs of cavitation, diagnosed as bronchiectatic. Daily evacuation of large quantities of foul, purulent sputum occasionally blood streaked. The disease progressing gradually, artificial compression pneumothorax was made at the Loomis Sanatorium. This resulted in collapse of the upper normal part of the lung with little effect on the diseased portion. There was, however, some improvement in the general condition with slight gain in weight and with less sputum.

Bronchoscopy by Doctor Yankauer demonstrated the disease confined to the left lower lobe.

Life was intolerable to the patient and she asked for operative relief.

Operation, December 16, 1920, Private Pavilion, Mount Sinai Hospital. Anæsthetic administered by Doctor Branower. First assistant, Doctor Neuhoof. Procedure: Long seventh interspace incision with removal of seven inches of the eighth rib with its periosteum. Incision then carried up behind the border of

the scapula dividing the seventh and sixth ribs. Lower lobe was contracted and solid. Upper lobe showed a few small patches of discoloration, suggesting possible areas of bronchiectasis. Adhesions few and easily divided. Lobectomy at once performed because it was believed that the conditions were safer now than they ever would be again. Operation easy and bleeding slight. No transfusion. Counter-opening in lower part of the back with resection of a short piece of the tenth rib and through this opening airtight tube drainage was secured. The principal wound was then closed with pericostal and muscle sutures, skin being left open and packed with a strip of gauze. Condition at the end of operation excellent.

Post-operative Course.—A sharp reaction with temperature to 104° and pulse 130 twelve hours after operation. In twenty-four hours after operation, abdominal

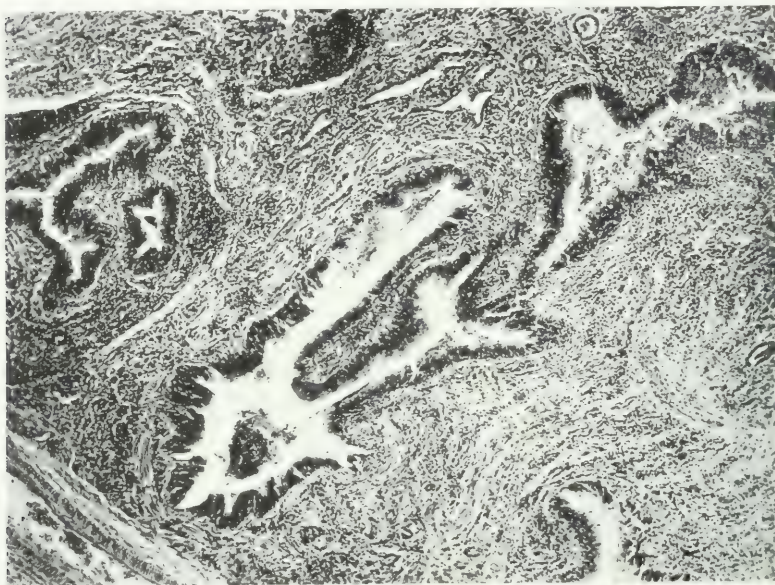


FIG. 27.—Bronchiectasis, longitudinal section of bronchial branches, showing peribronchial infiltration and fibrosis.

distention with cyanosis and dyspnoea and the continuous belching of enormous quantities of gas accompanied by brownish-black, foul-smelling fluid from the stomach. Abdominal distention at first relieved by rectal irrigation, but the patient quickly failed and died fifty-nine hours after operation. No post-mortem examination.

A few days after the death of this patient Doctor Neuhoﬀ happened to meet a physician who resided in the tropics and who stated in regard to a fatal abdominal case of Doctor Neuhoﬀ's in which curious whitish bodies were present on the viscera that he believed that the disease from which Doctor Neuhoﬀ's patient died was sprue, which is endemic as a visceral disease in the West Indies, where my patient resided. A fatal outcome of the condition, peritonitic in character, frequently occurs after any capital operation, no matter what its character may have been, and so well known is this condition that in the presence of sprue one does not operate except in emergencies. Doctor Neuhoﬀ suggested that this might have been the case with my patient, and I then recalled that she had had an indolent ulcer of the posterior right part of the tongue. This was called to my attention by the nurse

during the post-operative period. I did not think that the condition at that time would influence the result. Unfortunately no culture was made. As soon as I knew of the possible complication of sprue I requested Doctor Aschner who had the lung specimen to try to isolate the monilia. This, however, was impossible, as the specimen had already been put into antiseptic preserving solution. It is interesting to know that the above facts in regard to this disease are being studied by Colonel Ashford for the United States Army at San Juan, Porto Rico, and that a number of articles on this subject have been written.

CASE XX.—*Bronchiectatic Lung Abscess—Exploratory Thoracotomy.* Morris U., forty-two years old, was admitted to Mount Sinai Hospital April 10, 1920. Epilepsy for past five years. Eleven months before admission hæmoptysis of about a drachm. A month later began characteristic signs and symptoms of

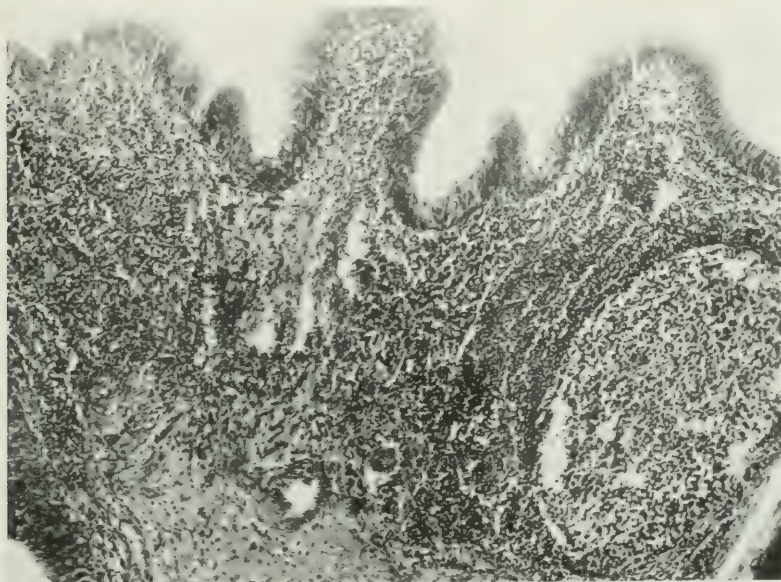


FIG. 28.—Bronchiectasis, mucosa more highly magnified.

pulmonary suppuration on the right side. Since February, 1920, cough, fever, loss of weight.

Physical examination showed signs of infiltration of right lower lobe and this was confirmed by X-ray examination. White blood-cells 8200; polymorphonuclears, forty-two. I refused to operate, but patient threatened suicide because he could not even find a place in a sanitarium on account of the fetor of his expectoration. Wassermann examination negative.

On April 12, 1920, I operated, making wide exploration of the right chest. Most of the upper lobe free but remainder of lung solid and adherent. Adhesions were broken down and chest closed to await second stage. April 19th, patient was doing badly, with signs in opposite chest. Still, in nitrous oxide and oxygen by Doctor Branower, I reopened the wound and opened and packed the abscess, not attempting lobectomy. No pleural infection was found at second stage, but he died half an hour later.

A wound examination showed the opposite lung diseased much as was the right side, though this had not been diagnosed by X-ray. Doctor Yankauer and I feared preoperative bronchoscopy because of epilepsy.

CASE XXI.—*Suppurative Bronchiectasis; Lobectomy, Left Lower Lobe.* J. M. W., twenty-three years old, was referred to me by Dr. James A. Miller on September 22, 1920. From the age of three this patient had suffered from nasal sinusitis, and there was an operation on the frontal sinus at that early age. Since then there were numerous other operations and the sinuses are still infected. The patient had influenza pneumonia twice. Cough had been present for six and a half years with purulent expectoration, usually foul but without blood. The amount varied from 250 to 400 c.c. per day. No tubercle bacilli were found. There were numerous exacerbations with fever. Clubbing of the fingers was present.

The X-ray pictures showed opacity of the left lower lobe but the right lung did not appear to be perfectly clear. The viscera of the patient were completely transposed.

Doctor Miller had treated the case with nitrogen pneumothorax and the X-ray then showed adhesions of the region of what might be the middle lobe

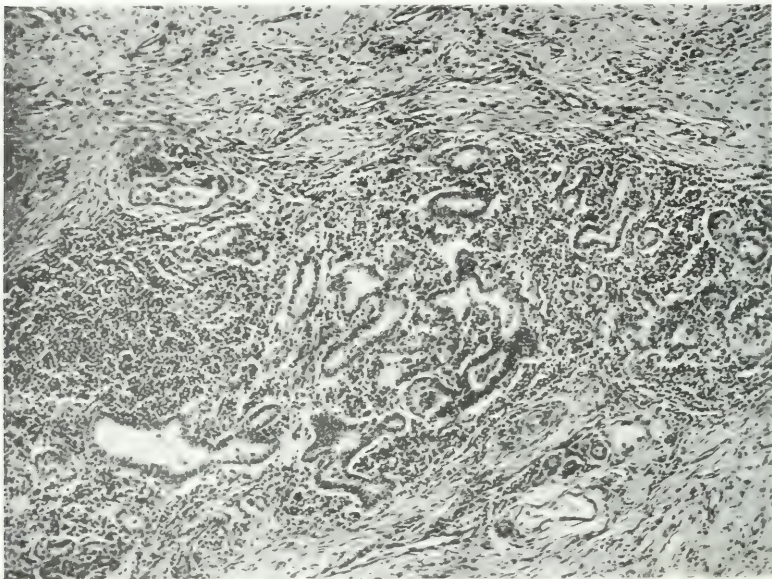


FIG. 29.—Proliferation of air passages in an area of fibrosis.

to the chest wall and of the lower lobe to the diaphragm and chest wall and so the collapse of the lower lobe was only partial. Bronchoscopy by Dr. Chevalier Jackson had been done in the hope of finding a possible foreign body, but none was found. On my advice another bronchoscopy was performed by Doctor Yankauer, who reported that the principal seat of disease with dilatation of the bronchi was in the left lower lobe, though the upper lobe did not appear to be perfectly clear. The right lung, however, was not diseased. No middle lobe bronchus was found. In the presence of the nasal infection, which was probably the prime cause of the entire pulmonary trouble, I hesitated to advise operation and suggested pulmonary lavage, but the patient refused this, preferring an operative attempt at cure. Operation was performed on October 27, 1920, at Mount Sinai Hospital. Anæsthesia in ether, then gas and oxygen by the intrapharyngeal method, with occasional suction (Doctor Branower).

Operation.—First stage. A long seventh interspace incision was made with resection of about eight inches of the eighth rib, including the periosteum. About

seven ounces of sanguinolent fluid was found in the chest. To our surprise the greater part of the lung was normal in appearance and density, the diseased area being rather dark and sharply defined, occupying the lower half of the left lower lobe, where on handling coarse crackling was made out and pus appeared at the patient's mouth. The two adhesions shown by the X-ray were broken down without the slightest difficulty and at these two points there was what appeared to be recent lymph coagulum. As preparation for a possible second-stage resection, gauze was placed between the upper lobe and the chest wall so as to cause adhesions and another piece of gauze was then placed between the lower lobe and the diaphragm. The chest was then closed without drainage by suturing the muscles, the skin left open and packed with iodoformized gauze. The patient stood the operation well.

Two days later, in nitrous oxide anæsthesia in bed, a few of the muscle sutures were removed from each angle so that the gauze could be withdrawn.

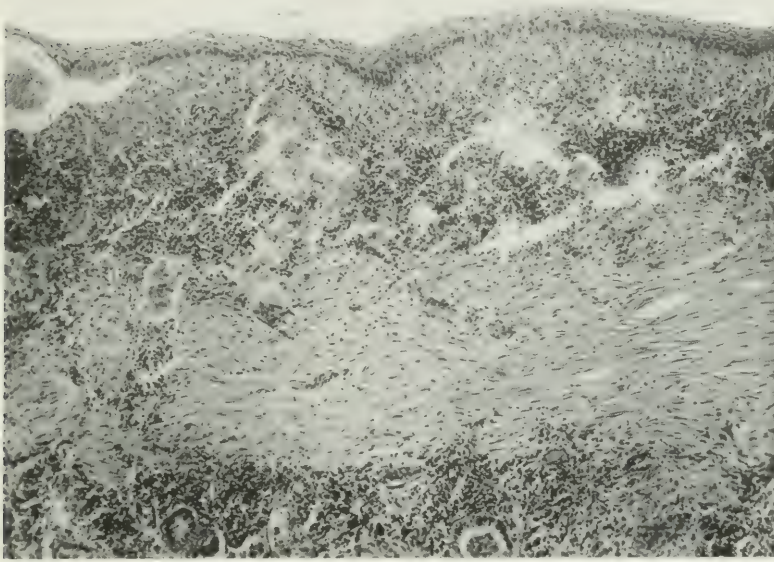


FIG. 30.—Bronchiectatic abscess wall, section near entering bronchus showing epithelial lining of cavity and muscular coat still present.

About a pint of non-odorous, sanguinolent fluid escaped. The wound was then strapped to prevent sucking.

Operation.—Second stage. On November 3, 1920, the patient having been prepared for forty-eight hours with digitan the lung resection was done. The anæsthesia was administered by Doctor Branower. First assistant at the wound, Dr. Harold Neuhof. Wound reopened by cutting sutures and rib-spreader inserted. No fluid found. The diseased part of the lower lobe was adherent to the diaphragm, upper and middle (?) lobes adherent to the chest wall. During the operation it was necessary to loosen some of the adhesions of the upper lobe to the chest wall, but a number remained firm posteriorly. The middle lobe was not fully developed, although a sulcus of demarcation was present. The infected part of the lower lobe was cut away beyond numerous ligatures of chromicized catgut and silk passed through the healthy pulmonary tissue. This made an unusually broad base or pedicle. The seventh rib was cut through posteriorly

and a short section, about an inch and a half, was removed for drainage. Another drainage opening was made into the back, through which a large-calibre tube was passed between the ribs into the chest low down. The stump area was carbolized and the ligatures tied together with a fillet of silk. This mass of ligatures was passed through a hole in a large piece of rubber dam which embraced the neck of the pedicle, broad though it was, and then this sack of rubber dam was filled with gauze, the entire mass of rubber dam, gauze and ligatures being led out through the upper posterior part of the wound. The mediastinum was steadied by traction made by fastening the bunch of ligatures to the chest wall. Three pericostal sutures approximated the ribs to within about three-quarters of an inch of each other and the remainder of the thorax was closed with chromicized catgut sutures through the muscles in two layers; skin wound left open. After the operation the patient was considerably shocked, although the blood-pressure which before the operation

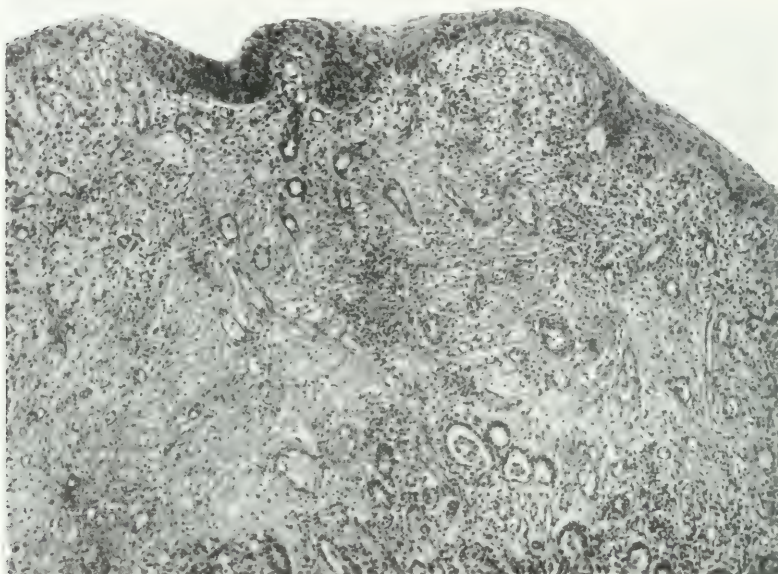


FIG. 31.—Bronchiectatic abscess wall, a more peripheral area, showing epithelial layer covering vascular granulation tissue.

had been 115-100 had been reduced to but 100 systolic. Doctor Ottenberg then transfused by the citrate method 700 c.c. of blood.

Post-operative Course.—The convalescence was far from simple. A section of the stump came away fifteen days after operation and two days later the other section, but a transfixion ligature which had been put in for security was very slow to be dislodged, finally coming away twenty-eight days after the lobectomy. For a time the sputum almost disappeared and the cough improved greatly. By December 6th, however, some sputum had reappeared (about 90 c.c. per twenty-four hours) and this has continued up to the present time. About four weeks after the lobectomy when everything seemed favorable a pneumonia developed in the right lung which caused me great concern. It cleared up, however, without leaving any trace. A small bronchial fistula persisted at the time of his discharge from the hospital on January 17, 1921, but it finally closed completely. A note on April 4, 1921, stated that the "wound is healed; patient in fine general condition, but there are still about two and one-half ounces of expectoration." A tube

through the lower drainage opening was not removed until a mere narrow track was all that was left of the cavity.

This patient cannot be considered cured because he still has some cough and expectoration. He has submitted to other nasal operations since the lobectomy but the sinuses are still infected. Judging by the most recent X-ray pictures it appears possible that there is a small patch suppurative in character near the site of the resection. Whether this is an extension or not it is impossible to know. At the time of the operation all visible and palpable pathological lung tissue was extirpated.

CASE XXII.—*Suppurative Bronchiectasis—Lobectomy Left Lower Lobe—One Stage.* Miss Josephine E., eighteen years old, entered Mount Sinai Hospital June 17, 1921. For nine years she had cough with purulent sputum. Her tonsils

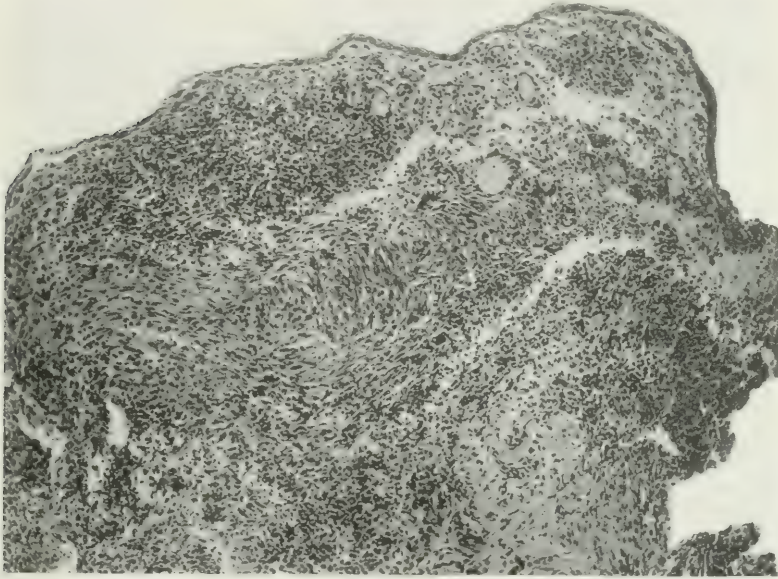


FIG. 32.—Bronchiectatic abscess wall, a remote area showing thin squamous epithelial lining.

had been removed a year before her admission, this of course having no relation to her disease. The amount of sputum was great and the odor indescribably foul. There were periods of emptying with comparatively little sputum in the intervals. For a year she had been treated bronchoscopically nearly every week by Doctor Yankauer, who kept her condition tolerable by lavage of the dilated bronchi, which were clearly observed through the instrument. During the three months preceding her admission, however, there had been a loss of twenty-two pounds in weight. There was no fever and no tubercle bacilli had been found on repeated examination. The breath had a gangrenous odor. There was slight dulness and few râles at left base posteriorly. There was clubbing of the fingers. The general nutrition was fair in spite of the great loss in weight. Urine examination negative. Blood Wassermann negative.

The X-ray showed opacity occupying the lower part of the left lower lobe. The right chest was apparently free. Doctor Yankauer stated that the disease was limited to the left lower lobe.

Her parents had been opposed to operation, but when she became eighteen years

of age she took matters into her own hands and insisted upon a chance with surgery, although well aware of the great dangers.

On June 20, 1921, I performed a left lower lobectomy, Dr. Harry Goldman beginning the administration of the anæsthetic, which was continued by Dr. L. Mason Lyons, House Surgeon. Sodium citrate given intramuscularly. Doctor Neubof and Dr. Ira Cohen assisted. Although the patient had apparently emptied her pus focus before operation, a considerable quantity escaped during narcosis.

Procedure.—A long seventh interspace incision extending upward behind the scapula with section of the eighth, seventh and sixth ribs. The upper lobe was adherent to the pericardium in its lower anterior part, the upper portion of the lobe being free. This lobe showed a small atelectatic area not larger than a silver quarter and not infiltrated. The lower lobe was adherent to the diaphragm by a few

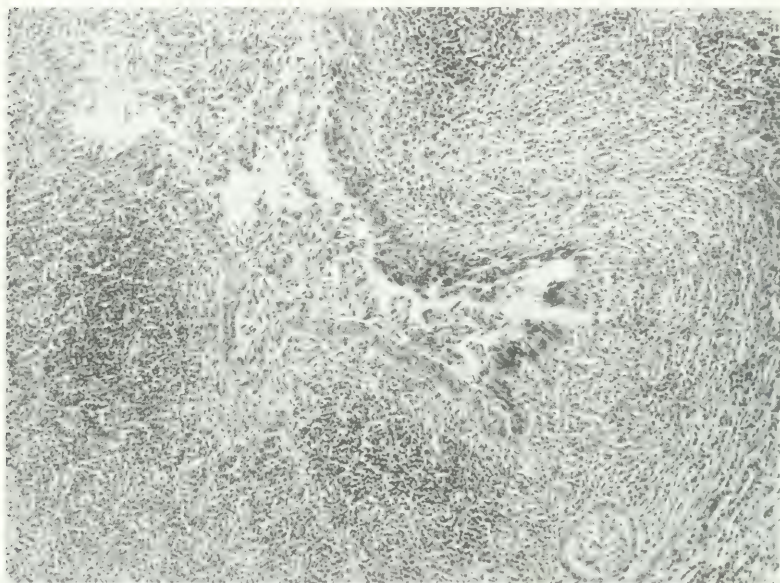


FIG. 33.—Bronchial branch with beginning epithelial metaplasia.

tough but fine adhesions which were easily divided. The lobe was not discolored, but it felt more fleshy than normal and there were dense nodules within the lung tissue with numerous large nodes in the hilum. Although there were no adhesions of the upper lobe and the case therefore should have gone into the two-stage group, the conditions were so tempting for an immediate lobectomy that I carried out this plan according to my present technic. Twenty-four hours after operation there had been free drainage of bloody serum and the patient received 300 c.c. of citrated blood. Three days post-operative the upper part of the wound was opened and the gauze changed. Soon afterward there were signs of tense pneumothorax with the heart pushed to the right. The cause of this proved to be the accidental slipping out of the tube, although it had been fastened to the fascia with a catgut stitch. A separate chamber had established itself in the wound on the mediastinal side and it was in this chamber that the pneumothorax had occurred. The tube was at once replaced and suction established. The patient was immediately relieved and in a few hours the heart was in its normal position. Nine days after operation there occurred a pneumonia on the opposite side with rapid respirations and much prostration. On July 5th there was a large bronchial fistula,

but the stump had not yet come away. Respirations had been so rapid for the past two days that I closed the entire thoracic wound with adhesive plaster and an occlusive wet dressing which gave the patient much relief. Three weeks after the operation the main slough came away through the upper wound and the patient's condition became good. On July 18th—twenty-eight days after the operation, when she was nearly well with only a small tube in the lower cavity, there was a sudden and dangerous hemorrhage. Fortunately Dr. Ira Cohen happened to be present. The removal of the tube was followed by a gush of blood and some blood was also coughed up, the patient going into a condition of shock. Doctor Cohen at once reopened the small granulating upper wound and packed the chest as well as he could and the patient was taken to the operating room, where I examined her in nitrous oxide and oxygen. I recognized that there

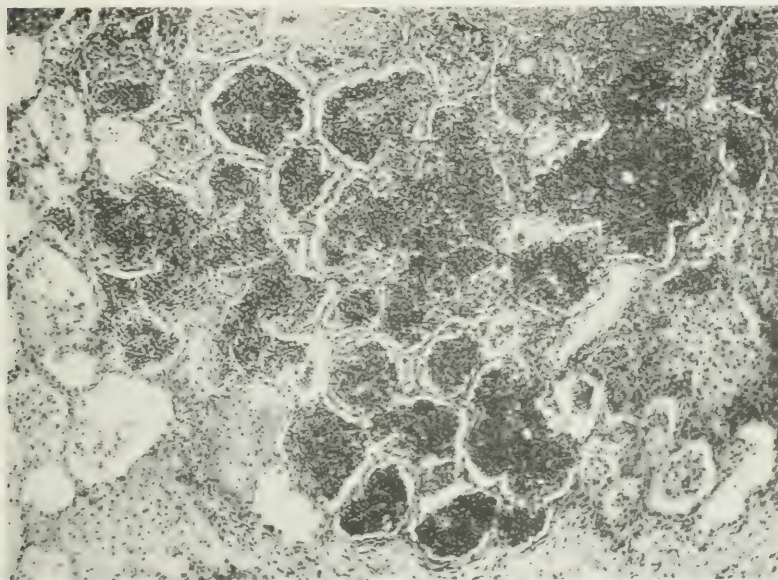


FIG. 34.—Suppurative pneumonitis, purulent exudate in alveoli, septa breaking down.

were two places where the hemorrhage might have originated. The most probable was erosion of an intercostal artery by the drainage tube. The other was from the region of the stump which would have been much more serious. On removing the packings there was an alarming hemorrhage, and because I wished to inspect the most dangerous region first I crashed through the soft parts and new bone with a large rib cutter and opened about four inches of the wound, putting in a rib-spreader. The stump was perfectly clean and there was no sign of bleeding there. The lower wound was then immediately enlarged and a rib resected. A spurting intercostal, evidently the source of bleeding, was caught in a hæmostatic suture. A few hours later Dr. N. Rosenthal gave a transfusion of 240 c.c. of whole blood by the Unger method. From this time on recovery was uninterrupted and she was discharged late in July with the wounds not quite healed. November 14, 1921, the patient having reentered the hospital because the upper wound was still discharging moderately, I removed a rib sequestrum in light anæsthesia. There were slight hæmoptyses for two days after operation but the patient's general condition is excellent. She is up and about and will leave the hospital tomorrow with a clean granulating wound, this time, it is hoped, "for good." Careful

measuring of the sputum, no longer foul, showed only from one-half to three-quarters ounce in twenty-four hours and the amount is rapidly diminishing. Prognosis for permanent cure excellent.

CASE XXIII.—*Bronchiectatic Lung Abscess—Right Lower Lobe; First-stage Lobectomy.* Max L., sixteen years old, was transferred from the Medical Service of Doctor Libman at Mount Sinai Hospital to my service on May 11, 1921. A nasal operation of some sort had been performed four years previous; three years before there had been pneumonia which the patient believed was right-sided; about two years before, tonsillectomy had been performed and about one and one-half years previous, without immediate apparent cause, there began productive cough with foul expectoration, and he entered the hospital for the relief of this condition. On admission he was in good general condition, although he was

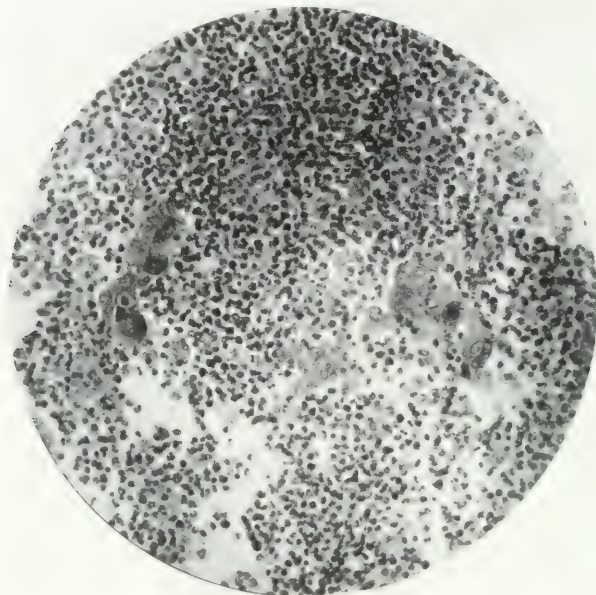


FIG. 35.—Suppurative Pneumonitis, higher magnification.

slightly cyanotic and there was infiltration of the right lower lobe. Examination of the blood showed the hæmoglobin to be 110 per cent., red blood count 5,200,000, and blood-pressure 106 over fifty-six. The sputum was negative for tubercle bacilli. The X-ray showed a shadow in the right lower lobe which suggested suppurative bronchiectasis. Bronchoscopy by Doctor Kempfer revealed pus coming from the bronchi, but the patient was unmanageable and the examination was unsatisfactory. A thoracotomy for exploration was advised and performed on May 12, 1921, in general anaesthesia with nitrous oxide and ether, administered by Doctor Branower. Doctor Neuhoef assisted at the wound. Sodium citrate was injected intramuscularly.

Operation.—A long seventh interspace incision was made, the eighth rib was divided posteriorly and the rib-spreader inserted. Adhesions of the upper lobe made intrapharyngeal pressure unnecessary. Thin, tough adhesions to the chest wall and diaphragm were encountered in the middle and lower lobes and these were divided with knife and scissors. There was very little hemorrhage. In the anterior lower edge of the lower lobe there were spots of atelectasis, bluish

in color. When the lobe had been almost completely freed it was found to be dense and hard—almost tumorlike in consistency—the greater part of the disease being in the posterior part. A hole was cut in a large piece of rubber dam and through the opening the diseased, isolated lobe was drawn in order to prevent reformation of adhesions. A small posterior resection of the eighth rib was made and the wound was closed in layer sutures, three pericostal chromicized catgut sutures approximating the ribs. No drainage.

Post-operative Course.—There was a reaction temperature of 102 plus. The patient's condition was apparently good. His pulse was about 115 but of good quality. The sutures were removed three days post-operative and a number of pus foci were found beneath the muscle sutures. A wet dressing was applied. Fluoroscopy on the fourth day post-operative showed a perfectly clear upper lobe with a shadow in the lower half of the chest but no displacement of the heart. This was interesting as the physical examination showed the apex far to the left of normal. The left chest was clear. On the fifth day the pulse became rapid and thready. There was no cyanosis. The wound was dressed and an opening made between the ribs into the chest, evacuating some very bloody serum but no clots. He suddenly collapsed and died.

A wound examination revealed no infection in the pleural cavity, no large quantity of bloody serum. The upper lobe of the right lung was normal; the lower lobe showed multiple abscesses with bronchiectatic areas and very large lymph-nodes in the hilum.

CASE XXIV.—*Bronchiectatic Lung Abscess from Foreign Body—Right Lower Lobe Extirpation.* This case has been reported in full in the ANNALS OF SURGERY for July, 1916. This is merely a very brief abstract.

Francis W., age three and three-quarters years, had a chronic gangrenous, diffuse bronchiectasis limited to the right lower lobe following the aspiration of some partly masticated nuts. Doctor Yankauer had succeeded in removing most of the fragments through the bronchoscope but without curing the condition. The patient's general condition was very poor. There was much spasmodic cough and foul expectoration.

On February 27, 1914, Doctor Branower gave ether by the intrapharyngeal method and I performed complete lobectomy through a seventh intercostal incision without dividing a rib. There was complete recovery and the patient has remained well and has developed symmetrically.

CASE XXV.—*Chronic Suppurative Pneumonia of Right Lower Lobe—Lobectomy.* This case has been reported in the ANNALS OF SURGERY for July, 1916. Following is a brief abstract of his history. Lawrence F., Hospital Accession No. 31,838, age eight years, was admitted to the service of Doctor Koplik of Mount Sinai Hospital on February 27, 1915. Seven months before admission pneumonia, followed in two or three weeks by a second attack. Cough persisted. Four days before admission fever, cough, and occasional vomiting. The child had gained weight continually during the seven months before admission. In this respect he was abnormal, probably suffering from some form of dyspituitrism. The respirations were thirty-two to sixty-four; the pulse 100 to 144; the temperature 100° to 104.8°.

X-ray examination showed the right lower lobe almost solid and sharply marked from the remainder of the lung which appeared healthy.

On March 1st he was aspirated in the right posterior axillary line and one-half a drachm of pus was said to have been obtained. I first saw him the following day. A diagnosis of pulmonary suppuration was made and on March 4, 1915, I operated in intratracheal anesthesia, administered by Doctor Branower. Three minims of Magendie's solution had been ordered for this patient, to be given three-quarters of an hour before operation.

Operation.—Through a long seventh interspace incision without cutting ribs the lobe was extirpated. Small resection of eighth rib for drainage.

Post-operative Course.—The operation was well borne with very little loss of blood. The pulse at its conclusion was 140 and the color pink and good. Soon after the patient went to the ward the respirations dropped to about ten and were extremely irregular, although the heart was beating 120 and strong. There was cyanosis and the patient looked dangerously ill. Doctor Branower made artificial respiration by intrapharyngeal insufflation and with the aid of this and one-three hundredth grain of atropine, he revived. It was later found that one-fifth of a grain instead of one-tenth of morphine had been given. The day after the operation the respirations were sixty, the pulse was 145, but the condition did not appear dangerous. Convalescence was in this case unimpeded, although on March 14th the temperature rose to 105.2° without explanation. He was discharged well on May 18th with some contraction of the right side. This deformity rapidly disappeared and four and one-half years later he was perfectly symmetrical, well and strong.

CASE XXVI.—*Suppurative Bronchiectasis—Two Lobe, One Stage Lobectomy—Death.* Sarah G., Hospital No. 168,034, six and one-half years old, was referred to my service at Mount Sinai Hospital by Doctor Koplik on November 27, 1916. She had had measles at one year of age and whooping-cough followed by pneumonia two and one-half years before admission. Chicken-pox and pneumonia seven months before admission. The illness for which she was brought to the hospital was supposed to have begun two and one-half years before at the time of her whooping-cough pneumonia. The outstanding feature of this case was cough, with expectoration, and fever. Frequently the coughing, which was paroxysmal, was followed by vomiting. The expectoration was extremely foul. The fingers were clubbed. On examination the right lung showed dullness beginning just below the angle of the scapula with amphoric breathing at the right base. The urine was negative. The blood showed 3,400,000 red cells; 7200 white cells; polymorphonuclears fifty-two per cent.; lymphocytes thirty-eight per cent.; basophiles two per cent.; eosinophiles three per cent.; myelocytes one per cent.; mononuclear lymphocytes four per cent.; hæmoglobin seventy-two per cent. On admission the temperature was 99.8°; pulse 100 and respirations twenty-four.

X-ray examination showed dense shadow at the right apex. Peculiar formation of dense shadow in lower lobe.

Bronchoscopy by Doctor Yankauer revealed the right bronchus pressed upon by something from without and pus exuding from it. There was also pus from the left main bronchus but Doctor Yankauer thought this might have run in from the right. It was not possible to enter the right bronchus.

This was considered a case for exploratory thoracotomy and on November 27th I operated, Doctor Branower administering nitrous oxide and ether by the intrapharyngeal method. Doctor Ware was first assistant.

Operation.—Through a long right seventh interspace incision the exploration showed the middle lobe to be normal and larger than usual. The right upper lobe was grayish and firm in consistency. The seventh, sixth and fifth ribs were now divided posteriorly and ample space was obtained. A few adhesions were divided and the right lower lobe was crushed with a clamp a little beyond the hilum. The clamp was then removed, a series of catgut suture ligatures were put in and the lobe cut away. It was then found that the lower lobe was in quite as bad a condition as the upper and it was removed by the same method. The ligatures of the upper lobe were cut short; those of the lower lobe were left long and were fastened to the chest wall to steady the mediastinum. There was little hemorrhage, only one vessel in the hilum of the lower lobe requiring separate

ligation. A low posterior stab wound was made for drainage. The time of the operation was fifty-five minutes.

Post-operative Course.—The operation was followed by considerable shock, but the patient recovered quickly and in less than an hour was wide awake, perfectly conscious, and asking for Seltzer water. For four days there was steady improvement. The usual foul discharge from the sloughing stump appeared and most of this was drained through the lower opening by the use of a suction apparatus. At the end of the fourth day following the operation I had great hope for a recovery, but at six o'clock on the morning of the fifth day, having been left alone by her special nurse with the side of the crib down, the child fell out of bed. At once there was shock, cyanosis, irregularity of the pulse, and for the next eight hours sinking until she died twelve hours after the accident.

It is by no means certain that recovery would have taken place in any event, but the immediate change in condition after the accident causes me to believe that this shock had much to do with the fatal termination.

CASE XXVII.—Pneumonic Lower Lobe Lung Abscess (Suppurative Pneumonia)—Extirpation of Left Lower Lobe—Death. Joe S., twenty-eight years old, was transferred from the Medical Service of Mount Sinai Hospital on July 15, 1919, and on the same day I operated. Eight weeks before he had had a sharp pneumonia and six weeks before he had begun to expectorate large quantities of fetid sputum. His temperature had varied from subnormal to 104° , but was running more nearly normal when I saw him. His general condition remained good and there was no clubbing of the fingers. Bronchoscopy by Doctor Yankauer showed secretion from the upper and lower lobes. X-ray examination showed a large abscess with infiltration occupying about the middle of the chest, so that it was difficult to make sure whether both lobes were diseased or not. He had been prepared with digitalis for two days previous to his transfer.

Operation.—In local anaesthesia, a long seventh interspace incision was made, the pleura opened and a large part of the eighth rib was resected. Because of distress due to mediastinal motion, the operation was then continued in general anaesthesia by the intrapharyngeal method (Doctor Branower). Both lobes were found to be involved and the abscess firmly adherent to the posterior chest wall. Adhesions to the diaphragm were found everywhere on the lower surface of the lower lobe and after releasing them the pedicle was easily loosened and cut off behind chain ligatures of chromicized catgut. This was not difficult because of the absence of the dense infiltration ordinarily encountered here. The stump and raw posterior chest wall were carbolized. Two other openings were made with small resections of rib for drainage by tube, one in the lower part of the chest and the other in the upper end of the wound where the long ligatures also protruded. The main wound was closed, burying the sutures and upper tube. Lower drainage wound closed airtight around the tube, the end of which was carried beneath the surface of lysol solution under the bed.

Post-operative.—No shock followed the operation, but a large amount of bloody discharge came away through the tube. The pulse gradually rose to 108, but was of good quality. There was some abdominal distention, but no vomiting. Two days afterward I was obliged to leave town, and on the third day post-operative death occurred from sudden heart failure with oedema of the lungs.

CASE XXVIII.—Suppurative Bronchiectasis—Two-stage Lobectomy—Death. The following is the first case in which I performed lobectomy in two stages. This was after I had been convinced by Dr. Samuel Robinson of the advantage of securing adhesion between the healthy lobe and the chest wall before removing the diseased lobe. This principle appears surgically sound and from the standpoint of the anaesthesia should add much to the ease and safety of the operation.

K. G., Hospital No. 168,297, a man thirty-two years old, was admitted to

Mount Sinai Hospital on November 22, 1916. From the age of twelve he had been in the habit of drinking from eight to ten glasses of beer a day; otherwise his history was unimportant. The pulmonary condition for which he sought relief began about a year before, following an attack of influenza. The principal symptom had been cough, with thick, yellowish expectoration, often colored with blood. Five months before admission there began a series of severe pulmonary hemorrhages, the last one seven weeks before. In spite of climatic treatment and good care in an institution his condition became steadily worse. There appeared pain in the right upper thorax, especially on coughing, and there were attacks of vomiting. There were signs of consolidation in the right upper thorax running down to the middle of the chest. The urine showed nothing abnormal. The blood-pressure was 105 over 65. Numerous examinations of the sputum failed to reveal tubercle bacilli. Fever was moderate, pulse on admission ninety-six, respirations twenty-four. Wassermann blood examination was negative. Complement fixation test for tuberculosis was negative.

X-ray Examination.—The X-ray showed dark infiltration from the right apex to the interlobar fissure, where it was sharply limited. The appearances were those of pneumonic infiltration which is often associated with bronchiectasis.

Bronchoscopy.—On November 28, 1916, Doctor Yankauer found by the bronchoscope that secretion was coming from the upper lobe branch of the right bronchus, but this branch could be entered only a short distance because of swelling of the mucous membrane. The middle and lower lobe branches were dilated to twice their normal size but contained no secretion. The left bronchus was normal.

Operation.—I operated on December 7, 1916. Doctor Branower administered the anæsthetic (ether, nitrous oxide and oxygen) by the intratracheal method. An incision was made in the seventh interspace over healthy lung and the rib-retractor put in. The X-ray findings were corroborated and there were dense adhesions of the upper lobe of the lung to the chest wall, the lower lobe being free. The lower lobes were now brushed briskly with gauze, the parietal pleura was wiped with gauze and then brushed with tincture of iodine and the chest was closed by suture without drainage, while the lung was expanded by the intratracheal pressure.

It was hoped that this treatment would cause adhesions to form where they were desired. The wound healed by primary union without reaction and on December 18, 1916, I performed the second stage of the lobectomy, Doctor Branower again administering the anæsthetic by inhalation.

The seventh, sixth and fifth ribs were divided close to their angles through a vertical incision connecting with the former operative wound. The rib-spreader was put in and at once it was seen that sufficient adhesion had formed to hold the lower lobe to the chest wall, simplifying the anæsthesia. The middle lobe was firmly adherent anteriorly and its appearance and texture on palpation appeared normal. The upper lobe was densely adherent to the anterior chest wall and was not all diseased, but it was soon found that the entire lobe would have to be sacrificed because of disease near the hilum. The pedicle was cartilaginously hard and could not be crushed even by a powerful clamp, which had been made by Doctor Yankauer and which worked on the letter-press principle. The operation was continued with great rapidity, quickly peeling the lobe from the chest wall, ligating the pedicle with silk and ablating it in the usual manner. The stump was carbolized. A drainage opening was made posteriorly by a small seventh rib resection. The chest was entirely closed so that there should be as little immediate respiratory embarrassment as possible. Doctor Branower inflated the lower and middle lobes of the lung just as the last sutures were tied.

Post-operative Course.—The pulse was of excellent quality and about 120 in rate; respirations thirty. The temperature was normal until December 20th, when it rose in the evening to 103°, and on the fourth day the wound was dressed without anæsthetic, the patient sitting up. There was fetid discharge which had oozed out of the wound between the sutures. The wound in the chest wall was at once widely opened and packed with iodoformized gauze. For the first post-operative thirty-six hours the cough, which had been constantly present before, disappeared completely. Then it recurred with slight expectoration. We found it impossible to sterilize the wound and impossible even to check the sloughing which had begun under the cutaneous stitches. The case resembled one of those which were seen so often during the War of gas gangrene of the chest wall and after a noble fight the patient died of sepsis on December 27, 1916, nine days after the second stage of his operation.

Remark.—The two-stage method can not be blamed for the death in this case, but probably the closure of the skin by suture made the propagation of the anaerobes more rapid. It is from this case that I came to the conclusion not to suture the skin after even the simplest lobectomy. The discussion of the relative value of the one- and two-stage methods is taken up elsewhere in this paper.

CASE XXIX.—*Suppurative Bronchiectasis of Right Lower and Middle Lobes—Two-stage Lobectomy—Death.* Gussie P., twelve years old, was admitted to Mount Sinai Hospital on January 31, 1921, with a temperature of 99.8°, pulse of 104 and respirations twenty-six. She had coughed since she was three days old. There was considerable thick, green sputum, especially in the morning, and there was pain in the lower right chest. Physical examination showed dullness and bronchovesicular breathing with moist râles over the lower right lobe. There was no clubbing of the fingers and the expectoration was not fetid. An operation for nasal polypi had been performed. Bronchoscopy by Doctor Yankauer revealed purulent secretion from all the branches of the right bronchus and what was considered overflow coming from the left. X-ray examination showed infiltration with consolidation in the right lower lobe.

An operation preparatory to lobectomy was performed on February 24, 1921, Dr. Ira Cohen, first assistant. Intrapharyngeal anæsthesia by Doctor Eliasberg, of mucopus and during he anæsthesia about twenty ounces were discharged.

At request just before the anæsthetic the patient coughed up about ten ounces of mucopus and during the anæsthesia about twenty ounces were discharged.

Procedure.—A long seventh interspace incision entered the chest and retraction was made with the rib-spreader. The lower lobe, while not dusky in color, was of a peculiar appearance, showing numerous minute nodules over its surface which were easily detected by sight as well as by touch, so that the viscus looked as if infiltrated with many metastases. The middle lobe was less visibly involved and the upper lobe appeared normal to touch and sight. A long section of the eighth rib was now removed for the sake of gaining space at the next operation. A strip of iodoformized gauze, single thickness, was placed between the upper lobe and the chest wall so as to make adhesions, and the wound was closed in layers with suture of muscle but not of skin.

Before tying the last suture an attempt was made to distend the lung but with doubtful success.

An X-ray picture taken March 9th showed a clear lung at the left side and with the general condition of the patient apparently good the lobectomy was undertaken. Nitrous oxide and oxygen, with a little ether, administered by Doctor Branower. Dr. Ira Cohen assisted at the wound.

Procedure.—The wound was quickly reopened and two more ribs were cut upward at the posterior angle. The rib-spreader was inserted. Adhesions had formed between the upper lobe and chest wall posteriorly. The lower and middle

lobes were covered with lymph and densely adherent to the surrounding parts. The lower lobe was separated bluntly from the diaphragm and from the upper and middle lobes and was extirpated beyond numerous transfixion ligatures of strong twisted silk. The child's condition was not good enough to warrant extirpation of the middle lobe also. The ligatures were left long and were tied together. The ligatures and stump which had been carbolized were brought through a perforated rubber dam which was loosely packed with iodoformized gauze. The ligatures, packings and rubber dam were brought out from the posterior part of the wound, the ligatures being fixed with a safety pin so as to steady the mediastinum. Considerable blood was lost and during the remainder of the operation the child received a saline infusion intravenously. The wound was now closed by three pericostal chromicized catgut sutures and muscle sutures. A few tubes were placed in the costophrenic sinus anteriorly for further drainage. The second wound was packed with iodoformized gauze.

Post-operative Course.—Immediately after the operation 250 c.c. of citrated blood were transfused. An hour after the operation the temperature had risen to 106 degrees, and in spite of the steadying of the mediastinum there was practically a sucking wound. This was overcome by firm strapping and the respirations became much easier. The child never reacted, however, and there was great rattling in the throat on respiration. Death occurred seven hours after the completion of the operation with hyperpyrexia of 108 degrees.

Post-mortem.—A wound inspection showed surgically perfect conditions in the right chest. The middle lobe, however, was bronchiectatic. The upper lobe was erected normally. The left lung was pneumonic and showed small areas of disease, probably bronchiectatic in character.

Pathological diagnosis by Dr. F. S. Mandlebaum.

CASE XXX.—Infected Mediastinal Dermoid Cyst—Carcinoma of Cyst Wall—Secondary Bronchiectasis—Resection of Right Lower Lobe—Drainage of Cyst—Death. Miss E. R., thirty years old, a patient of Dr. A. Peskind, of Cleveland, had for many years expectorated foul pus and for about seven years the quantity was fully twelve ounces a day. There were occasional hæmoptyses. A drainage operation a year before I saw her had not benefited her and the wound had closed, but even while it was open and draining the cough continued uninfluenced. She consulted me on September 22, 1921, a well-nourished but slightly cyanotic girl, a scar just behind the right mamma, fingers clubbed, dullness and râles in the right lower chest. The X-ray showed a peculiar shadow in the right lower thorax which we interpreted as a bronchiectasis. The possibility of suppurating dermoid had been also considered, especially by Doctor Neuhoof. Bronchoscopy by Doctor Yankauer revealed much pus coming from the dilated right lower bronchus. The patient was prepared for operation. Blood-pressure 115-84. Operation September 26, 1921, Doctor Branower anæsthetizing (intraparyngeal) with gas, oxygen and ether and Doctor Neuhoof assisting at the wound. The patient was given sodium citrate intramuscularly.

Procedure.—A long sixth interspace incision with resection of the seventh rib was made. The entire lower half of the chest was filled with adhesions, obliterating the pleural cavity. Orientation was effected with difficulty and the right lower diseased and shrunken lobe, the size of a small orange, was resected beyond numerous transfixing ligatures. On section the pedicle showed greatly dilated bronchi. The patient's condition being excellent and only a moderate loss of blood having occurred, a further exploration was made, when a cavity containing pus and sebaceous material with hair was opened. It was fully the size of a lemon and contained a large nipple-like mass of embryonal skin attached to the mediastinal region. This was cut away beyond ligatures, the cavity packed with

iodoformized gauze and the usual drainage of the stump accomplished. There was no danger of mediastinal flapping because of numerous adhesions.

Post-operative Course.—The operation lasted fifty minutes and the patient's condition at its termination was encouraging. Pulse-rate 120; fair quality. I felt that I had every reason to hope for a recovery. As soon as the patient was transferred to the stretcher, however, there was sudden collapse with weakness of the pulse, and, although she regained consciousness, had no pain and was able to drink water, she died of shock ten hours after the conclusion of the operation.

CASE XXXI.—*Bronchiectatic Lung Abscess; Middle and Lower Lobes—Major Thoracotomy and Exploration.* Charles J., Hospital No. 197,461, thirty-seven years old, was admitted to Mount Sinai Hospital December 21, 1919. About a month before had been operated upon for gastric ulcer and appendicitis and there supervened pneumonia with hiccough. Then came cough, bloody sputum and pain in right chest. Loss of sixteen pounds. Night sweats, etc. Physical examination showed dulness in right chest posteriorly with diminished voice and breathing. Blood showed 10,000 white cells and ninety-two per cent. polymorphonuclears. Fluoroscopy showed limitation of movements of the right diaphragm and the plate was interpreted as pneumonia of right lower lobe. Bronchoscopy by Doctor Yankauer showed mucopus from the middle lobe bronchus and from second branch lower lobe bronchus. Lavage was done once, but patient refused further bronchoscopical treatment. In spite of treatment under Doctor Manges, disease progressed and exploration with probable lobectomy was decided upon.

February 16, 1920, at first-stage operation, upper lobe found free but dense indurated mediastinal portions of middle and lower lobes were seen. Diseased lobes partly mobilized and upper lobe prepared by gauze packings for second stage.

Second stage never performed because of poor reaction following first stage. Procedure was difficult and one and one-quarter hours were consumed. After operation there was severe shock. Thirty hours later citrate transfusion of 400 c.c. of blood. Three days after operation the wound was reopened. Convalescence was slow. There was much foul discharge but patient gradually recovered, the large wound filling by granulation. About two months after operation patient was discharged still unhealed, but there was final recovery, and he is apparently well at this writing.

HISTORICAL SUMMARY

Gluck, Schmid, Block, Biondi successfully extirpated lung experimentally about 1884.

Stretton, Tuffier, Doyen, Lowson, Sonnenburg and McEwen resected lung for tuberculosis. (Recovery.)

Lowson removed successfully a tuberculous lung apex the size of "half a fist."

Tuffier delivered a lung apex through an intercostal incision and removed a portion of it experimentally.

Doyen resected the remains of a right lower lobe in which a large hydatid cyst had previously been drained.

Garré excised a lower lobe for bronchiectasis by first resecting a sufficient number of ribs to cause a caving in of chest wall sufficient to permit the delivering of the lobe and extrathoracic treatment of the stump at a subsequent operation.

TABLE OF CASES*
(Pathology by Dr. Ascher)

No.	Name	Age	Sex	Cause	Location of lesion	Type of operation	Pathological anatomy	Complicating pathology	Result	Remarks
1	Mrs. E. M. B. . .	33	F	Post-tonsillectomy infection	Middle lobe	One stage lobectomy	Bronchiectatic abscess	Pneumonitis	Well	1000 c.c. of mucus per day
2	Mrs. C. M.	28	F	Post-tonsillectomy infection	Upper left lobe	One stage resection of lobe	Bronchiectatic abscess	Pneumonitis	Well	Has gone through severe typhoid fever without lung complications
3	W. A. B.	26	M	Post-tonsillectomy infection	Right lung	One stage sub-total pneumectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Patient has apparently permanent incomplete pneumothorax and wears a small tube to prevent recurrent empyema. No symptoms
4	Miss S. K.	16	F	Post-tonsillectomy infection	Right lower lobe	Two stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Death	Shock
5	Miss E. B.	33	F	Post-tonsillectomy infection	Middle & upper lobes	One stage single lobectomy	Bronchiectatic abscess	Pneumonitis	Death	Shock
6	Miss J. K.	32	F	Post-tonsillectomy infection	Right upper and lower lobes	One stage resection of lower lobe	Bronchiectatic abscess	Pneumonitis	Death	Shock
7	Sylvia M.	84	F	Post-tonsillectomy infection	Right upper lobe	One stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Is studying fancy dancing
8	Rose F.	12	F	Post-tonsillectomy infection	Right lung	One stage pneumectomy	Bronchiectatic abscess	Pneumonitis interstitial	Death	(Edema of opposite lung. See series of radiographic pictures illustrating progress of disease)
9	Mrs. J. P.	30	F	Post-tonsillectomy infection	Both left lobes	One stage partial lobe resection	Bronchiectatic abscess		Death	Shock. Case actually inoperable because of dense adhesions from previous attempted drainage
10	Miss M. V.	11	F	Post-tonsillectomy infection	Right lower lobe	Two stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Studies fancy dancing
11	Gertrude K.	8	F	Post-tonsillectomy infection	Left lung	Two stage total pneumectomy	Suppurative pneumonitis		Death	Septic infection diaphragm. Death 13 days postoperative from hemorrhage from stump
12	Abraham G.	8	M	Post-tonsillectomy infection	Left upper lobe	Major thoracotomy and exploration			Improvement	Relapse and bronchial fistula; again in hospital
13	Jacob S.	36	M	Unknown	Right lower lobe and part of upper lobe	Attempted extrapleural resection			Death	
14	David J.	16	M	Unknown	Middle lobe and part of adjoining lobes	One stage resection of middle lobe and part of adjoining lobes	Suppurative pneumonitis		Well	Followed for two years
15	Jacob K.	5	M	Unknown	Right lower lobe	One stage lobectomy	Suppurative pneumonitis	Abscesses	Death	Death probably due to mediastinal flapping
16	Joseph S.	25	M	Unknown	Right lower lobe	One stage lobectomy	Suppurative pneumonitis	Pneumonitis	Death	Death probably from cerebral metastasis
17	Charles G.	37	M	Unknown	Right lower and middle lobes	First stage of lobectomy	Bronchiectasis		Death	Septic pneumonia
18	Fannie B.	16	F	Unknown	Left lower and part of upper lobe	One stage lobectomy, left lower and part of upper lobes	Bronchiectasis		Well	

19	Mrs. A. M.	26	F	Unknown	Left lower lobe	One stage lobectomy	Bronchiectasis	Death	Death probably due to visceral sprue
20	Morris U.	42	M	Aspiration (?) epilepsy	Right lower and middle lobes	Two stage attempted lobectomy	—	Death	N-ray failed to show disease in other lung; revealed by post-mortem. No bronchoscopy because of epilepsy
21	J. M. W.	23	M	Congenital (?) later infected	Left lower lobe	Two stage lobectomy	Bronchiectasis	Still some cough and expectoration	Case of transposition of viscera
22	Miss Josephine E.	18	F	Unknown	Left lower lobe	One stage lobectomy	Bronchiectasis	Convalescent	Nearly well
23	Max L.	16	M	Unknown	Right lower lobe	First stage of lobectomy	—	Death	Cardiac failure
24	Francis W.	3 $\frac{3}{4}$	M	Foreign body	Right lower lobe	One stage lobectomy	Bronchiectasis	Well	—
25	Lawrence F.	8	M	Chronic suppurative pneumonia	Right lower lobe	One stage lobectomy	Suppurative pneumonitis	Well	—
26	Sarah G.	6 $\frac{1}{2}$	F	Whooping-cough pneumonia	Right upper and lower lobes	One stage lobectomy (2 lobes)	Bronchiectasis	Death	Immediate cause of death fall from bed with tearing loose of traction ligature between lung and chest wall
27	Joe S.	28	M	Pneumonia	Lower left lobe	One stage lobectomy	Suppurative pneumonitis	Death	Death probably from pneumonia of opposite side
28	K. G.	32	M	Post-influenza infection	Right upper lobe	Two stage lobectomy	Bronchiectasis	Death	Anaerobic infection of wound; death from sepsis
29	Gussie P.	12	F	Probably congenital, later infected	Right middle and lower lobes	Extirpation of lower and middle lobes — two stages	Bronchiectasis	Death	Death with temperature to 108 soon after citrate transfusion
30	Miss E. R.	30	F	Infected mediastinal dermoid cyst	Right lower lobe	One stage lobectomy	Bronchiectasis	Death	Shock. Had diagnosis been made drainage of cyst should have preceded lobectomy
31	Charles J.	37	M	Post-operative aspiration pneumonia	Right middle and lower lobes	First stage of lobectomy	Bronchiectasis	Apparently well	Second stage not performed because of dangerous reaction following first stage

* For conscience's sake I will mention here one case which is not included in the table because it was a mere exploration, not even an intended lobectomy. It is given here to round out every bit of personal operative experience with this disease which I have had in the period covered by this paper. The patient was a soldier in France who following a mouth operation developed an acute gangrene of the right upper lobe. I exposed the lobe by thoracotomy and the patient expired on the table. It was not a true bronchiectatic case because only a few days had elapsed since his infection.

Heidenhain reported a successful removal of left lower lobe for bronchiectasis. Two previous operations had been performed with drainage of several large bronchiectatic cavities. Rib resections had been performed at each of the preliminary operations. Patient remained with bronchial fistula.

Rehn, Bardenheuer, König, Garré, Trendelenburg and others, tumors of chest wall with removal of greater or lesser portions of lung.

Helferich removed two complete lobes. Patient died seventeen hours post-operative.

Murphy: Unsuccessful attempt to resect lung.

Veerhoogen: Partial resection of lower lobe of left lung for a tuberculous cavity in a man of thirty-five. Patient shown six weeks post-operative. No further data.

Gerulanos: Reports Helferich's case in which middle and lower lobe of right lung resected for breast sarcoma.

Stretton resected upper lobe right lung for tuberculosis successfully.

Friederich: In two cases resected left lower lobe for bronchiectasis in a pneumatic chamber. Both patients died five days post-operatively when bronchial stump gave way and they developed a tension pneumothorax.

Müller resected right lower lobe for tuberculosis in a child. Patient died three weeks post-operative.

Körte resected right lower lobe for bronchiectasis successfully in a boy. Boy still alive four years after operation. No further report.

Kümmel resected an entire lung in forty-eight-year-old man for carcinoma. Patient died six days after operation of œdema of the remaining lung.

W. Meyer, in 1914, made the statement that sixteen cases of pneumectomy for bronchiectasis had been reported in the literature, of which eight were cured or improved and eight died.

Robinson: Five cases of pneumectomy for bronchiectasis with one death. All done in several stages.

First stage consists of subperiosteal resection of ribs.

Second stage opens pleura and if conditions are favorable operation may be completed; if not, resection is done in third stage after packing chest at end of second stage.

In a later paper he reports seven cases with three deaths.

Hitzrot extirpated in stages a right lower lobe for suppurative bronchiectasis with lung abscess. Patient was presented at a meeting of the New York Surgical Society, February 11, 1920.

THE PATHOLOGY OF LUNG SUPPURATION

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SUPPURATIVE diseases of the bronchial system and the lungs have received relatively limited pathological study. I do not refer to the suppurative processes associated with tuberculosis, syphilis, and actinomycosis, nor to those consequent upon the breaking down of malignant neoplasms. The gross lesions produced by pyogenic organisms are described chiefly in clinical works. Microscopic details even in pathological texts are scant. A satisfactory classification is lacking and much confusion exists in the terminology employed. In former years our knowledge of the pathology was dependent for the most part upon autopsy material. The disadvantage was that the patient had either succumbed rapidly to a fulminating process, or had lived for some years with widespread extension, secondary processes and efforts at healing. When, therefore, Doctor Lilienthal undertook his series of lobe resections an opportunity to study the lesions under more favorable circumstances was presented. Doctor Wilensky began these studies and they were continued by me after he very generously gave me the material he had collected up to 1918.

It is my purpose at this time to present the results and the more important details of this study.

The infectious agents very evidently may enter the lung in the following ways: 1. Through the air passages. 2. Through the blood-stream, by way of the venæ cavæ and the right heart (embolic lesions). 3. By direct extension from neighboring structures. 4. By traumatic introduction through the thoracic parietes. Whether there is such a condition as primary suppurative pleuritis with secondary invasion of the pulmonary parenchyma by direct or lymphatic extension is still a moot question. We may be sure, however, that just as in peritonitis, primary infection of the serous pleural space and membranes is exceptional. As elsewhere in the body the factors of virulence on the part of the infectious agents and of resistance on the part of the invaded tissues and the attacked individual determine the pathological lesion. Certain aseptic lesions such as infarcts, and hæatomas resulting from subcutaneous injuries of the lung predispose to successful invasion by pyogenic organisms through the air passages or the blood-stream. Certain inflammatory processes such as pneumonia and influenza, ordinarily non-suppurative, are prone to secondary invasion by virulent pyogenic bacteria.

Whether or not suppuration will assume the physical characteristics which we call gangrene depends upon the kind of microorganisms (*e.g.*, anaërobæ), upon the extent of thrombotic processes in the affected tissues, and upon

the type of individual affected (*e.g.*, diabetic, marasmic, and cachectic individuals are prone to gangrenous processes).

It is of the greatest importance to remember that once pulmonary suppuration has been established it is very prone to spread to other parts of the lungs by way of the air passages and the lymphatics. A simple purulent process, moreover, may become gangrenous by the advent of factors enumerated above. Embolic lesions involving distant organs, notably the brain, the bones, and the joints, may occur by way of the pulmonary veins and the general circulation. The relatively frequent incidence of such complications in the empyemata of the recent influenza epidemics constitutes strong evidence of the origin of these empyemata from foci of pulmonary suppuration.

The specimens removed by Doctor Lilienthal fall into the following three groups:

1. Bronchiectasis (general)* 10 cases
2. Bronchiectatic abscess 10 cases
3. Suppurative pneumonitis 4 cases

From what has been said it is apparent that secondary changes occurring in the course of the disease occasionally make it difficult to classify the individual specimen. Thus a case of general bronchiectasis may be complicated by interstitial or suppurative pneumonitis, or, as a result of ulceration, by small bronchiectatic abscesses. A case of suppurative pneumonitis is apt to show some dilatation of the bronchi due to the accompanying infection of the bronchial walls, or the fibrosis of reparative processes. A bronchiectatic abscess is accompanied by pneumonitis, which in turn causes local bronchiolar dilatation. Nevertheless careful gross and microscopic study of the specimen will reveal its essential type.

A fourth group is that of Extrabronchial Abscesses. These occur in the parenchyma of the lung from several causes. An aseptic infarct or traumatic hæmatoma results in such a lesion when secondary infection takes place. Septic embolism of the lung produces parenchymatous abscess. In pneumonia, both lobar and lobular in type, the central part of a massive exudate may break down from impairment of the blood supply by pressure or thrombosis. If the causative bacteria are ordinarily pyogenic, or if the individual's resistance is low, or if secondary invasion by pus-producing organisms supervenes, smaller or larger areas of suppuration occur. Abscesses complicating lobar pneumonia are likely to be single, large and central. Those complicating lobular and broncho-pneumonia and those due to septic embolism tend to be multiple, small and peripheral. The broncho-pneumonia following influenza is especially prone to develop small peripheral abscesses, which often infect the pleural cavity by extension or rupture.

The tendency of abscesses of this group is to break into either the bronchial system or the pleural cavity, and nature attempts to cure them in these ways.

* By general bronchiectasis is meant dilatation of all the bronchi and bronchioles of one or more lobes of the same lung, in contradistinction to universal, by which is meant diffuse involvement of both lungs.

It is apparent that the specimens of suppurative pneumonitis contain extra-bronchial abscesses and that the borderline between the third and fourth groups is not very sharp. The term extrabronchial abscess should be used perhaps to designate those due to strictly localized suppurative pneumonitis.

Bronchiectasis (ten cases).—By this is meant more or less uniform dilatation of the bronchi and bronchioles. The process may be confined to one or more lobes of a lung, in which case it is designated general. It may involve both lungs extensively, in which case it is designated universal. Of the ten specimens examined, five involved the left lower lobe; two the right lower lobe; one the right lower and middle lobes; one the right upper lobe; one the right upper and lower lobes.

Etiology: For this reliance must be partly placed upon the clinical history. In three cases it is unknown. In two there is a history of extensive disease of the paranasal sinuses. Influenza, pertussis, and some form of pneumonia appear to be the causes in three. In one, foreign body aspiration is recorded. In another (Case 30) the pressure upon the bronchi by a mediastinal dermoid resulted in bronchiectasis. The wall of the cyst showed elements derived from the three embryonal layers and beginning carcinomatous changes were present in the glandular elements of entodermal origin. Narrowing of the lumen by intrabronchial tumors can produce the same condition. In two clinical cases of Doctor Yankauer's fibromas growing within a bronchus have caused bronchiectasis and suppuration. A polypoid lymphosarcoma arising from the submucous lymphoid tissue of a secondary bronchus was found post-mortem in another case.

Gross pathology: The lobe usually appears smaller than normal in size, dark blue or purplish in color. The pleural surface may be smooth and glistening, or dull and thickened, depending upon the amount of parenchymatous disease, and upon whether a one- or two-stage operation was performed. The lung crepitates less than normally and has a fine, nodular or shotty feel caused by the numerous terminal dilated bronchioles. The line of resection shows ten to twenty bronchial branches from one to two centimetres in diameter from which pus of varying consistency and odor exudes. The walls are thick and dense, the mucosa redundant, red or gray and soggy. They can be followed out to the periphery of the lung where they frequently end in small sacculations. In some of these sacculi the walls are ulcerated and terminal abscesses have formed. On longitudinal section of the lobe the richness and prominence of the dilated thickened air passages contrasts with the reduced parenchyma. The latter appears atelectatic with increased connective tissue, and may show areas of exudation or suppuration in the vicinity of the bronchial branches or at their terminations.

Microscopic pathology: The bronchial branches and bronchioles form a large part of the section. The mucous membrane surface is tremendously increased not only by the general dilatation, but by the throwing up of numerous rugæ producing a papillary appearance. The

layers of columnar ciliated epithelium are increased in number so that a relatively small radicle has an epithelial lining four or five cells deep.

The lumen contains an exudate made up of mucus, desquamated epithelia, lymphocytes, and varying numbers of polymorphonuclear leucocytes. The subepithelial stroma, the muscularis, and in more advanced cases the fibrosa are diffusely infiltrated by round cells and fibroblasts. Round cells are seen in the epithelial layer also. The peribronchial tissues show either inflammatory infiltration or increase of connective tissue and from the vicinity of the bronchioles thickened interlobular septa radiate. Elastica stains show that the normal elastic laminae are either entirely absent, or represented by strands frayed and broken by the inflammatory tissue.

The parenchyma in four specimens shows only a condition of partial atelectasis, the alveoli being small and their walls somewhat thickened. In three specimens a pneumonitis is present, most marked about the bronchioles and consisting chiefly of interstitial fibrosis, lymphoid foci, alveolar exudation and desquamation. In two the process is more acute and areas of suppurative pneumonia surround the bronchioles, the parenchyma in these areas being infiltrated with pus cells. In two cases the terminal saccules show partial destruction of the epithelium leaving a cavity lined chiefly by inflamed granulation tissue. In some the remaining epithelium is a single layer of cuboidal cells, but in others it appears flattened and stratified, suggesting metaplasia. The destruction of elastic elements in the parenchyma varies directly with the extent of pneumonitis.

To summarize, the chief lesions are dilatation of the bronchial system of the lobe, enormous increase of mucosal surface, round-cell infiltration of the stroma and muscularis, destruction of the bronchial elastic laminae.

Bronchiectatic Abscess (ten cases).—By this is meant a distinct type of pulmonary suppuration, which in this series has followed operation for removal of the tonsils and adenoids under general anæsthesia in every instance. It is remarkable that the constancy of the pathological lesion is paralleled by uniformity in the clinical history of the patients; namely, the development of fetid expectoration after an incubation period of thirteen or fourteen days following the operation. The distribution of the lesion is as follows: Two of the left lung, eight of the right; five are primarily in the lower, two in the middle, and three in the upper lobes.

Gross pathology: One-third to one-half of the lobe appears rigid and prominent, with a grayish yellow color of the involved portion and with thickened pleura. In a few cases the whole lobe presents this appearance. The line of resection shows four or five large bronchial branches, thick walled, somewhat dilated and exuding thick pus usually of foul odor. On tracing out the secondary bronchi one of them is found to lead into an irregular cavity of varying size and shape containing pus and necrotic material. From this cavity smaller bronchial radicles can be followed in various directions toward the periphery of the lung. Other bronchi traced

out from the line of resection show some dilatation and purulent content caused either by spilling over of pus into them from the essential lesion, or as a result of mechanical factors such as compression or displacement by the primary lesion and its secondary pneumonitis. In a few cases the primary lesion appears in the course of the main bronchus of the lobe and it has been entered in the course of the resection.

The interior of the abscess cavity presents a varying picture depending upon the age of the lesion, and the extent to which necrosis has gone on. In some the wall is relatively smooth and glistening, in others more or less granular and dull, in the oldest smooth, dull and fibrous. These appearances have a definite microscopic basis which will be described subsequently.

The appearance of the parenchyma on longitudinal section varies considerably with the age and extent of the disease. About the abscess cavity, the bronchial branch leading into it, and the branches passing out of it, the lung tissue is converted into a firm, indurated mass showing dense bands of connective tissue separating grayish yellow raised areas. The parenchyma in the distribution of the other bronchial branches may be fairly normal, markedly congested and friable, or may be the seat of a secondary interstitial or purulent pneumonitis. When the main lobe bronchus is the site of the abscess the whole parenchyma shows the fibrotic lesion.

Microscopic pathology: The pleura covering the diseased lung shows great thickening due to the presence of fibroblasts, numerous capillaries and lymph-vessels with swollen endothelial cells. The parenchyma is traversed by wide bands of connective tissue of varying vascularity and showing areas of round-cell infiltration, plasma cells and fibroblasts. The interalveolar septa are greatly thickened and infiltrated with round cells. The alveoli are reduced in size or completely obliterated by organization of preceding alveolar exudate. Masses of pigment appear in these areas and in the fibrotic septa. Alveoli near the periphery of the lung or in areas outside the distribution of the affected bronchus show a varying amount of interstitial inflammation and exudation containing many desquamated epithelial cells, round cells, and polymorphonuclear leucocytes. The elastic fibres in the most diseased areas are more or less completely destroyed. The blood-vessels frequently show endothelial thickening and hyaline degeneration.

A striking picture is observed in three cases. Islands of numerous duct-like structures, lined by low cuboidal epithelium, some apparently leading into alveoli, are seen in areas of dense fibrosis and remind one of the proliferation of the bile passages in cases of portal cirrhosis. In one of the earlier cases this feature was so prominent as to suggest malignancy.

Cross-sections of bronchial branches show round-cell and leucocytic infiltration, the subepithelial layer being converted into a vascular granulation tissue. The peribronchial connective tissue is similarly infiltrated. The amount of destruction of the elastic lamina depends upon the degree of infiltration of the wall.

The greatest interest centres about the wall of the abscess cavity. Sections taken through the bronchus and the beginning of the cavity show a remarkable transition from columnar ciliated to a stratified squamous epithelium lining the cavity in several specimens. Other sections cut far away from the entering bronchus and only a centimetre or two from the pleural surface show areas in which the granulation tissue is covered by a flat epithelium from one to three cells in depth. In other sections the wall is formed by a dense fibrous tissue beneath which large blood-vessels, and scattered mucous glands are seen, indicating its bronchial origin. In one specimen removed two years after the tonsillectomy the wall was fibrous and thick but smooth and no communication with a bronchus could be determined. Whether the cavity had become sealed off or whether the abscess was embolic and not of the usual type cannot be decided. The clinical onset was the same as in the others.

The presence of the epithelial lining and the gross pathology indicate without doubt that the usual post-tonsillectomy lung infection begins as a localized lesion in a bronchus. That the septic embolic lesion may occur cannot be denied. That a suppurative pneumonitis can occur is proven by a case in the third group, but a clinical course and pathological anatomy are entirely different. For the production of a localized bronchial lesion we must assume the aspiration of a piece of infected tissue or blood clot. The aspiration of mouth secretion or fluid blood, it seems to me, would produce a diffuse lesion such as is described by the term Suppurative Pneumonitis.

The presence of an epithelial lining in the cavity is one of the factors in preventing spontaneous healing, as is also the extensive fibrosis in the parenchyma. The epithelial lining would favor permanent fistula formation if pneumotomy were performed.

Concerning the mechanism in the cases of spontaneous healing no definite knowledge is available, but it must be either a complete epithelialization of the cavity or a total necrosis of the lining membrane early in the disease before fibrotic changes have appeared to prevent collapse of the cavity.

The bacteriological studies have been disappointing because of the great mixture of organisms, and the difficulties of anaërobic work with such mixtures.

Efforts to duplicate the lesion in dogs by means of intratracheal insufflation of pieces of tonsil and adenoid, pus from clinical cases, and cultures of anaërobres have been unsuccessful. Blood aspirated from the dog's femoral vein was injected with tonsil tissue and anaërobres without producing suppuration.

Suppurative Pneumonitis.—By this is meant a pathological condition of rather varied appearance involving one or more lobes and the result of widespread infection by way of the air passages. The lesion may be primarily suppurative as in cases of submersion and aspiration, or secondarily suppurative as in cases of broncho-pneumonia following influenza.

Four specimens belong in this group. One consists of left upper and lower lobes of a child who developed grave pulmonary signs a few days after a tonsillectomy. The lobes are large, heavy and reddish on the surface. On section numerous bronchial branches exude pus. The parenchyma is yellowish brown and gray, and studded with miliary foci of suppuration. The whole parenchyma is pus-soaked. This does not in any way resemble the pathology in Group 2, and the clinical history is very different.

A second specimen is from a case of pneumonia following a gall-bladder operation. Here the process is of longer duration. The bronchi show thick infiltrated mucosa. The parenchyma show areas of interstitial and organizing inflammation, and other areas of purulent infiltration and miliary abscesses, due to breaking down of the alveolar septa. One abscess cavity the size of an egg communicates with a bronchus, and its wall consists chiefly of vascular granulation tissue. It shows, however, several areas covered by flattened epithelium, three or four cells deep.

A third specimen, supposedly pneumonic in origin, shows several gangrenous cavities communicating with the bronchial tree, and a parenchyma fibrosed and infiltrated. Cuboidal cells line the cavities in part.

The microscopic sections indicate that abscesses in these cases may originate in terminal bronchioles, or in the parenchyma with secondary perforation into the bronchial tree. Secondary dilatation of the bronchioles was more noticeable in a fourth specimen, a case of broncho-pneumonia after pertussis.

Doctor Wessler believes that certain post-pneumonic gangrenes with an incubation period of two weeks are really aspiration abscesses similar to those ascribed to tonsillectomy. While conclusive pathological evidence is wanting at present, it is to be remembered that such cases are either not operated upon at all or they are operated upon only after a considerable period has elapsed, with consequent extensive secondary changes hiding the essential lesion.

SUMMARY

Lung suppurations may be divided into:

1. Bronchiectasis, a general disease of the bronchi in one or more lobes.
 2. Bronchiectatic abscess, a localized suppurative process in the course of a bronchus, and thus far observed only in post-tonsillectomy cases.
 3. Suppurative pneumonitis, a diffuse purulent process.
 4. Extrabronchial abscess, a localized purulent process.
- Certain interesting histological changes have been observed:

1. Metaplasia in bronchial epithelium.
2. Epithelial lining of bronchiectatic abscess and some smaller abscesses of Group 3.
3. Proliferation of smaller bronchioles and air passages resembling proliferation of the bile passages in portal cirrhosis.

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ABERRANT ADENOID CYSTIC EPITHELIOMAS OF THE SALIVARY GLAND TYPE

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THE records of any large surgical clinic reveal, from time to time, a tumor of the head or neck, which when competently studied microscopically is reported as an aberrant adenoid cystic epithelioma of the salivary gland type. But more often an erroneous interpretation results, and the pathologist and the surgeon remain uninformed as to the true nature of the malady. For this reason, the writer has undertaken to report a series of such neoplasms, in the hope that their true recognition may be fostered.

The subject of mixed tumors situated in the salivary glands, and in the neighboring structures, was, for many years, a hotbed of discussion. Virchow and Cohnheim expounded an epithelial origin. Wartman and Volkman, however, declared the origin to be not epithelial, but endothelial, from lymphatic channels. Krompecher, in Germany, and Ewing,¹ in this country, have written convincingly of the epithelial origin of all mixed tumors of salivary tissue. Their studies have shown the probable origin of contained cartilage, to be from a peculiar epithelial metaplasia.

Any one originating tissue, however, does not meet the requirements of each and every case. Branchial epithelial remnants may well be considered in certain cases. Many such tumors in salivary glands are derived from the ducts and acini. Ewing states that the wide distribution in lips, cheek, orbit and palate indicates strongly that their growth is from misplaced salivary tissue. The close developmental relationship between salivary and buccal epithelium explains why such aberrant rests are so often present in the mouth structures. Ewing quotes Krompecher as concluding that the mixed tumors of the salivary tissue belong in the class of basal-cell carcinoma, and especially in the subgroup of adenoid cystic epithelioma.

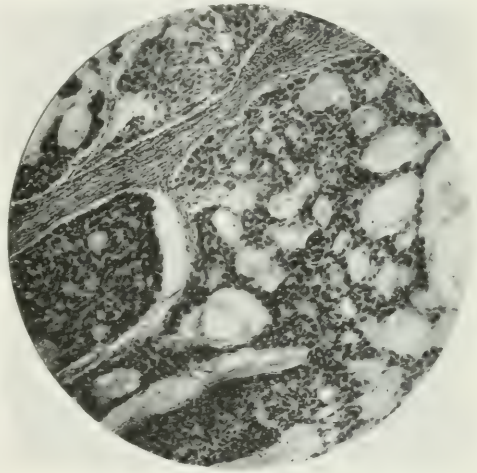


FIG. 1.—The structure presents various shaped cords, columns and groups of rather large epithelial cells, consisting chiefly of nuclei. They present the characteristics of basal epidermal cells. The cords surround many small collections of homogeneous mucinous material which appears to develop from mucous degeneration of the stroma. Some of these collections of mucous are larger, so that definite small cysts appear. The tumor belongs in the group of adenoid cystic epithelioma of salivary gland type.

A review of the clinical literature indicates the uncertainty that has in the past surrounded this type of growth as found in the hard palate. The oldest reference is the contribution by Rouyer,² of Paris, in 1857, in which is recognized an indefinite relationship between such tumors and salivary tissue. Reboul,³ of Marseilles, in 1892, reports the removal of a small, sessile, non-ulcerated tumor from the hard palate, together with an enlarged lymphatic gland, from the submaxillary space. Histological examination of both specimens showed the presence of irregular epithelial masses undergoing mucous and myxomatous changes. Fragments of cartilage were found. It was recognized as a mixed tumor of the salivary gland type. Defontaine,⁴ in 1893, describes a hard palatine

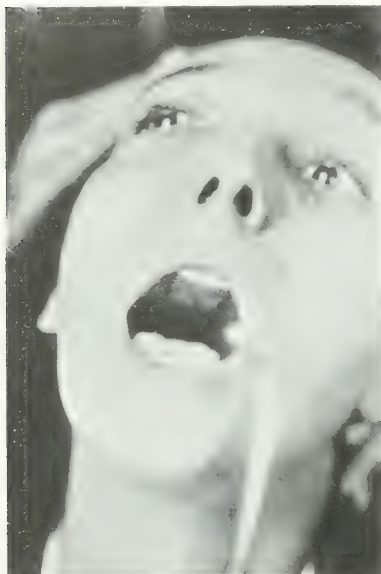


FIG. 2.—The typical appearance of a primary adenoid cystic epithelioma of salivary gland type as found in the tissues of the hard palate.



FIG. 3.—Adenoid cystic epithelioma, salivary gland type, occurring in the upper lip.

cystic growth, as an adeno-epithelioma. Beco,⁵ in 1895, refers to the removal of a plum-sized tumor from the hard palate of a woman, twenty-two years old. The tissue was reticulated like a normal parotid gland. Small cysts, filled with colloid material, were present. He called it an adeno-cancer. Berger,⁶ in 1897, says that the tumors of the hard palate which seem to be derived from the palatine glands and resemble the mixed tumors of the soft palate, belong to the sarcomata. Chaput,⁷ in 1900, excised a small, non-ulcerated, slowly growing tumor from the hard palate of a woman twenty years old. Histologically, it was encapsulated by connective tissue, and composed of irregular epithelial lobules, separated by bands of mucous tissue. He called it a cylindroma. Potherat,⁸ in 1903, reports the removal of a lemon-sized tumor from the hard palate of a woman forty-five years old. It had been slowly growing for ten years. The gross appearance was com-

pared to that of a normal parotid. He called it a fibro-adenoma. Workman,⁹ in 1903, excised a firm, rounded growth, situated between the mucous membrane and the periosteum of the hard palate. The microscopical report shows it to be of epithelial nature, but no exact diagnosis is ventured. Wood,¹⁰ in 1904, reports four mixed tumors of the palate, and four of the lip. Morestin,¹¹ in 1905, removed, with great ease, from the hard palate of an adult male, an encapsulated, indolent, non-ulcerated growth which he reports as a mixed tumor of doubtful origin. Such a tumor he says, is very rare in this location. McKenzie,¹² in 1907, writes of an encapsulated endothelial sarcoma, the shape and size of an almond. Marsdon and White,¹³ in 1910, reported a patient with a smooth, non-ulcerated, cystic tumor of the hard palate. This was shelled away from the bone without difficulty. Their histological analysis is that of a salivary mixed tumor. Manasse,¹⁴ in 1914, describes a typical endothelioma. In 1919, Finder¹⁵ reports a tumor of the hard palate, half the size of a lemon, and covered with normal mucosa. It had been present for six years, and he calls it a benign epithelioma.

From this résumé of the literature it is quite apparent that the same type of palatine tumor has received various interpretations. This is quite comprehensible, when it is considered how profoundly metaplasia may alter the histological characters. The more complete reports all agree that the lesion

is of slow growth, non-ulcerating and is of cystic character. No bone invasion is reported, but pressure atrophy of the palatine process is mentioned.

The Memorial Hospital records reveal five tumors occurring in the tissues of the hard palate, one in the upper lip, and one deep to the skin of the forehead, which were reported by Ewing, as adenoid cystic epitheliomas of salivary gland type.

Case II of the table received this typical pathological report. "Three stained sections show a basal-cell carcinoma of the salivary gland type, but there is no tendency to formation of cartilage. The cells are small, composed mostly of very hyperchromatic nuclei. The stroma tends to mucinous degeneration. Two of the sections show more active growth of the larger cells in alveolar arrangement."

The following tabulated report is compiled from the case records:



FIG. 1.—Case No. IV, clinically free of disease.

TABLE I

Case	Age	Sex	Total duration of lesion	Primary or recurrent	Gross characters	Treatment	Results	Initial diagnosis
1	29	F.	3 years	Recurrent on the hard palate 3 months after operation	Size 3:2.5:1.5, centimeters. Area of ulceration 1 centimeter in diameter, cystic	Buried emanation 6 millicuries	Clinically free of disease 1 year	Adenoid cystic epithelioma of salivary gland type
2	32	M.	2½ years	Recurrent on hard palate after 2 operations	Size 3:3:3 centimeters; no ulceration	Buried emanation 8.2 millicuries	Clinically free of disease for 1 year	Sarcoma
3	33	F.	1 year	Primary on hard palate	Size 3:3:1 centimeters. No ulceration, appeared as a smooth, globular tumor with elastic consistence	Buried emanation 8 millicuries	Clinically free of disease for 8 months	Sarcoma
4	57	M.	4 months	Primary on the hard palate; incised once as an abscess	Size 2:2:1 centimeters. No ulceration; appeared as a smooth, elevated tumor	Buried emanation 8 millicuries	Clinically free of disease for 10 months	Adeno-sarcoma
5	51	M.	3 years	Recurrent on the hard palate 5 months after operation	Size 2: 1: 0.5 centimeters. Ulcerated, granular tissue in a hollowed out palate	420 milligram hours of radium emanation filtered by ½ millimeter of silver	Clinically free of disease for 10 months	Glandular sarcoma
6	62	F.	7 years	Primary on the upper lip	Size; 4:3:2 centimeters. Pedunculated, non-ulcerated elastic consistence	Buried emanation 5.6 millicuries	Clinically free of disease for 1½ years	None given
7	43	M.	2 years	Prophylactic treatment of scar on forehead	No evidence of disease	594 millicuries hours of emanation, 1 centimeter distance, filtration ½ millimeter of silver and 2 millimeters of brass		Sarcoma, very malignant

An analysis of these records shows that two palatine lesions were observed in their primary state, and three were altered by one or more local operations. The gross character of the two unoperated lesions was identical, and corresponds very closely to the descriptions given in the clinical references. In Cases II and III, each patient presented a recurrent lesion after a very incom-

plete surgical procedure. The appearance was, however, so suggestive that a clinical diagnosis of adenoid cystic epithelioma of the salivary gland type was ventured, and was confirmed microscopically. It here may be stated that a primary lesion appears as a mound-like growth, springing from the hard palate close to the alveolar process. The overlying mucosa is intact. Ulceration would probably occur, following surgical misuse, or long neglect. The tumor is adherent deeply, and conveys to the palpating finger an impression of elastic firmness. Radiographic examination demonstrates no bone changes. No symptoms are produced, other than mechanical annoyance. Metastatic deposits are not present, and in no case did they occur subsequently.

Cases I, II, III and IV were treated locally by imbedding radium emanation tubes in the substance of the tumor. In Case V the recurrence was not bulky, so emanation tubes, filtered by one-half millimetre of silver, were applied by means of dental modelling compound. Only one treatment was found to be necessary to cause a complete primary regression of the disease.

Case VI is that of a patient presenting a very large, non-infiltrating and non-ulcerating growth of the skin surface of the upper lip. The actual pedicle of attachment was not more than one centimetre in diameter. Radium emanation tubes, buried in its base, caused a disappearance of the growth, and a restoration of the affected part, in a period of three months.

Case VII is that of an adult male referred for prophylactic radium treatment after two excisions of the growth, which was situated on the forehead adjacent to the right eyebrow. The tumor rested on the periosteum and was considered to be a very malignant sarcoma.

It is very significant that in only one patient was the palatine lesion recognized, clinically or histologically, before being referred for radium treatment. Sarcoma was the popular diagnosis, although in one instance this was varied to adeno-sarcoma. Case III was observed first at one of our leading hospitals. Here a small section was removed and pronounced by the pathologist to be sarcoma. The surgeon accepted the diagnosis without question, and considered that radium treatment held out more hope than an operation. Either procedure, if properly executed, would undoubtedly eradicate the disease.

CONCLUSIONS

1. Adenoid cystic epitheliomas of the salivary gland type, occurring in the tissues of the mouth and face, are not as uncommon as the literature would indicate. Such neoplasms have been reported, but not properly recognized, and histologically interpreted.
2. The tendency is to regard them as sarcomas. To this fact may be attributed some startling surgical cures.
3. The characteristic tumor has slight malignant properties. Therefore it does not ulcerate and invade in its early stage.
4. Radium treatment has been entirely successful in these cases.

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DIAPHRAGMATIC HERNIA*

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DURING the past few years interest in hernia through the diaphragm has received marked stimulus for two definite reasons. First, hernia through wounds of the diaphragm have been observed during the Great War in a comparatively large number of cases because of the penetrating and explosive force of high-powered modern missiles. Second, the X-ray with its greater range of efficiency has demonstrated this pathologic condition heretofore mostly determined only at operation or autopsy.

Frequency of Occurrence.—Up to the beginning of the Great War 650 cases of diaphragmatic hernia had been reported in the literature by Griffin. Of these 650 cases but fifteen had been diagnosed before operation or autopsy. Since the onset of the Great War there have been an increasing number of case reports of this condition. Within the past year Bevan has reported four cases. Portis, Mathews, Howk, Belden, Gresive, Cotte, Quentin, Hartung, Huffman, Nieden, Reichel, and Schlecht have each reported a case. Macmillan reports three cases of diaphragmatic hernia among 15,000 X-ray examinations made at General Hospital Number 1. Of these three cases two were traumatic hernias following shrapnel wounds. The third case was thought to be incident to an operation for empyema. A recent communication from the Mayo Clinic states that no cases of diaphragmatic hernia have been observed in their hospital since those reported by the late Doctor Beckman in 1916. At that time Beckman reported three cases, one seen in 1909, one in 1911 and one in 1916.

Etiology.—Anatomically, the diaphragm presents points of weakness which are consequently the most frequent sites of rupture. Most commonly the œsophageal opening presents hernial possibilities. The junction between the ensiform process and the costal cartilages is devoid of muscular tissue, as is the space posteriorly between the psoas muscles and the ribs; therefore, these regions oftentimes mark points of entrance of hernias into the thoracic cavity.

Congenital defects in one or both domes of the diaphragm may occur. The usual pathologic lesion seen, however, is an abscess of muscular tissue around the œsophageal foramen. This congenital opening may be large or small and will be limited latterly by the pillars of the diaphragm.

The exciting cause of acquired diaphragmatic hernia falls under two heads; namely, increased intra-abdominal pressure and direct injury. Increased intra-abdominal pressure sufficient to produce rupture of the diaphragm is seen in crushing accidents, long and difficult labors, persistent strain-

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ing at stool, etc. Direct trauma to the diaphragm is necessarily secondary to penetration of the chest or abdominal wall. Thus the projectile, dagger, bayonet and knife are the most common instruments of danger.

Contents of Diaphragmatic Hernia.—A rupture of the diaphragm having occurred either from congenital or acquired causes, there exists a direct communication between the abdominal and thoracic cavities. Because of the negative pressure in the chest during inspiration and positive pressure in the abdomen the hernia always passes through the hernial opening from the abdomen into the thorax. A hernial sack may or may not be formed. In fact, a true sack in the sense of a peritoneal pouch is seldom seen.

In 1897 Lichtenstern analyzed 250 cases of diaphragmatic hernia and pointed out that the stomach was the abdominal organ most frequently found in the thorax. Other abdominal viscera in order of their herniated frequency are transverse colon, omentum, small intestine, spleen, liver, pancreas, and lastly kidney.

Symptomatology.—Generally speaking no definite symptom complex can be given for diaphragmatic hernia. In either the acquired or congenital types of hernia the symptoms must depend very largely upon the size of the diaphragmatic opening, the degree of constriction and the organs involved. As a rule the symptoms are not commensurate with the anatomical defect. In the acquired type of diaphragmatic hernia, the symptoms are apt to be acute in accordance with the etiological factor entering into the cause of the rupture. In the congenital form of hernia the symptoms are generally chronic in character, accentuated at times by functional disturbances.

Summing up, we may expect symptoms that would follow a mechanical displacement of abdominal viscera from their normal abode to an adjacent cavity. Combined with the visceral displacement must be borne in mind the not infrequent occurrence of complications such as adhesions, constrictions, inflammation, obstruction, etc., of the hernia.

In face of such varying possibilities as to cause anatomical derangement and complications it can be readily understood that diaphragmatic hernia has no pathognomonic symptoms. Griffin has said that three subjective symptoms are present in a good percentage of cases. These are first, pain in the epigastrium and chest immediately after eating; second, paroxysms of smothering without apparent cause; and third, vomiting without premonition.

More accurate conclusions can be drawn from the objective signs. Thus the presence of abdominal viscera in the thorax may sometimes be determined by careful physical examination. X-ray examination is of the greatest value and exploratory operation is, of course, determinative.

Pneumothorax, subphrenic abscess and diverticulum of the œsophagus must be considered in the differential diagnosis. In case of doubt the X-ray can be depended upon to clear the question.

Treatment.—Surgery is the only curative treatment for hernia of the diaphragm. In operating two sites of approach may be considered; the thoracic and the abdominal, or, a combination of both. Unquestionably the

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abdominal route is the one of choice. When adhesions prevent the reduction of the hernia from below, a thoracotomy, though adding to the operative risk, may be necessary to enable the operator to free the hernia from above and restore its contents to the abdominal cavity. When a traumatic opening

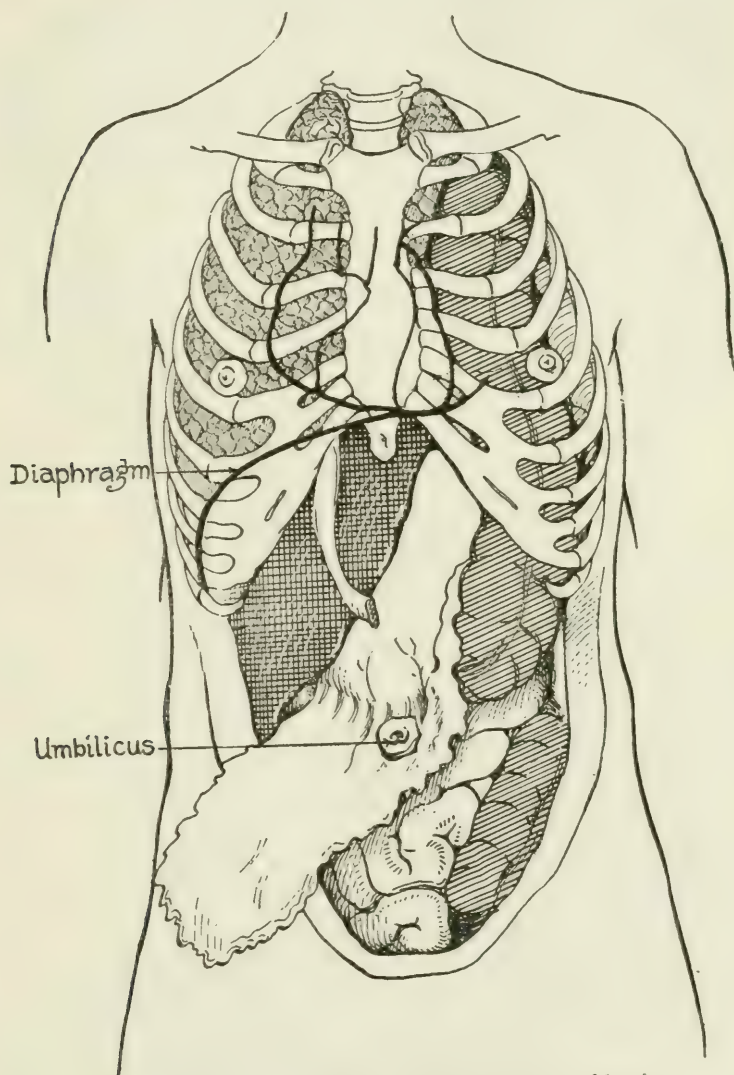


FIG. 2.—Heart shown displaced to right by contents of hernia.

exists in the chest as in some shell wounds or other cases the hernia may be repaired through it from above.

When operating from below a long left rectus or the S incision of Bevan is recommended for good exposure. With the abdomen open the technic of reduction and repair must depend upon conditions as found. Usually a

diaphragmatic hernia is reduced without difficulty; but, on the other hand, it may be necessary to incise a constricting ring or break up adhesions before accomplishing the desired result.

Repair of the hernial opening in the diaphragm is effected by bringing together the pillars of the opening. This is usually accomplished by placing interrupted sutures of catgut. Where the diaphragm is sufficiently lax, the edges of the opening should be overlapped and sutured to better insure permanent repair. In those cases where the opening is favorably situated it may be closed by suturing to the chest wall as in the case reported by Mitchell. If the opening is too large to close by suture the stomach, mesentery and possibly the omentum may be attached to the diaphragm in such a manner as to effectually close the rupture.

AUTHOR'S CASE.—Miss I. W. K., age twenty-five, nationality American, occupation trained nurse. Family History: Mother died of gastric cancer at the age of thirty-nine. Father died of pneumonia at the age of forty. One brother, age twenty-seven, and one sister, age twenty-three, living and in good health.

Previous History: Birth was normal. Her grandmother, who was present at her birth, states that patient was a small baby and that her mother had an easy labor. At the age of seven years she had a severe attack of whooping-cough that lasted for six months, threatening at one time to terminate fatally. During her childhood her parents always referred to her as being a delicate child. Indigestion and shortness of breath was always a constant complaint. At school she had no difficulty in mastering her work, graduating at high school in 1914. In the last year of her school she had her first so-called "spell." She was taken with severe and sudden pain in the lower abdomen accompanied with nausea and vomiting. The pain was radiating, first being on one side of the abdomen and then shifting over to the other side. This and subsequent attacks forced her to bed where she would remain for three to seven days until she gradually became better.

These attacks would recur at varying intervals of a week, month or several months. They would be ushered in without warning. Nothing in the character of these attacks drew her attention to the thorax for the pain was always in the abdomen. At times, however, she did have sensations of gas in the left chest.

In 1915 she entered a local hospital and assumed the duties of a pupil nurse, graduating in 1918. While in training she continued to have her attacks, but she was never sick enough to require the services of a physician. In 1917 her tonsils were removed, and in 1918 she was confined to bed for two days with what was then diagnosed pleurisy of the left chest.

Present Illness: At 4 A.M., April 28, 1920, patient was seized with a sudden and severe pain in the lower abdomen, which was typical of her usual attacks. This was accompanied with nausea and vomiting. On the following day, as her condition did not improve, surgical advice was requested. Physical examination at this time revealed the following:

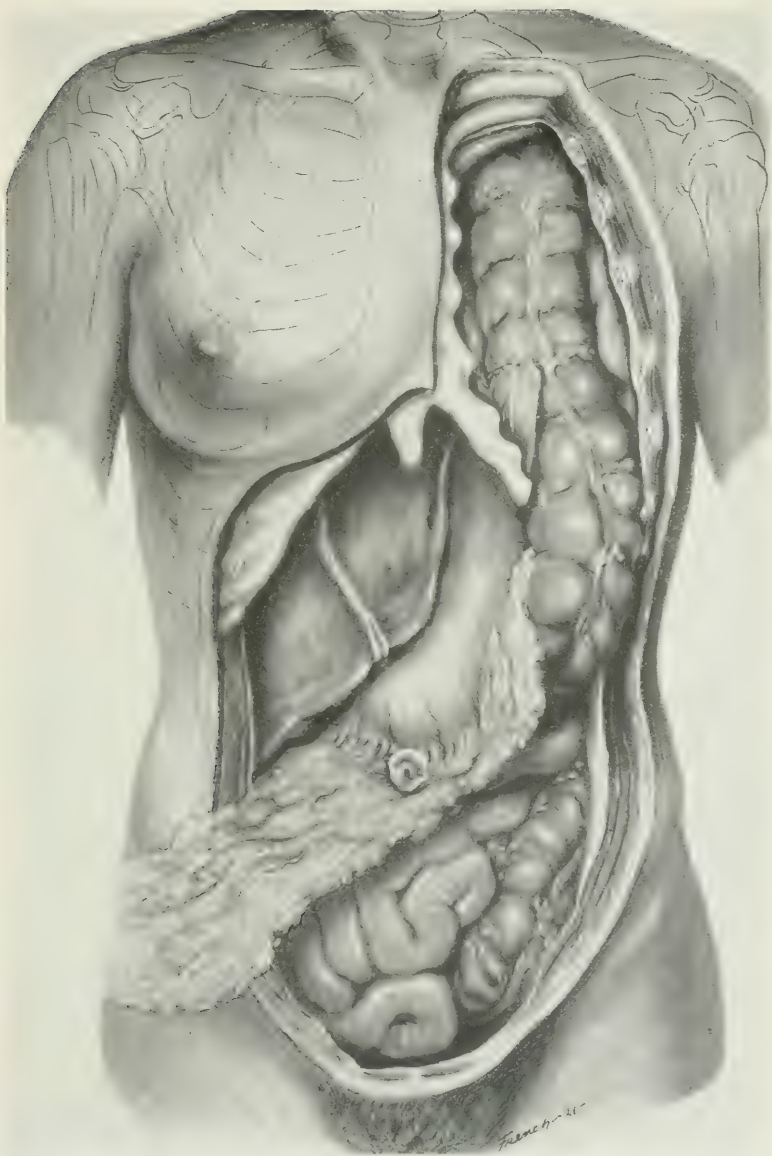


FIG. 1.—Diaphragmatic hernia before operation. Large opening in diaphragm and ptosis of stomach and liver may be noted. Insert showing displacement of heart to the right.

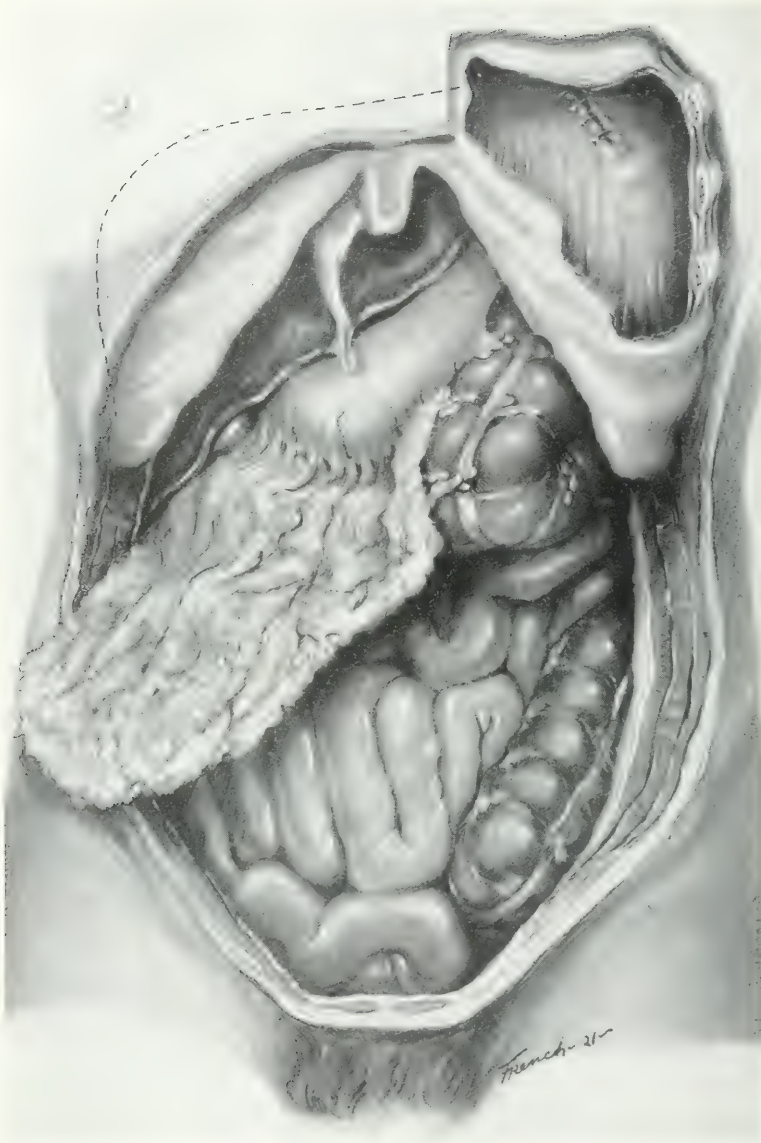


FIG. 3.—Diaphragmatic hernia after repair. Pillars of hernial opening sutured with interrupted chromic catgut.



FIG. 5.—X-ray demonstrating the presence of the large intestine in the left thoracic cavity. The lung is collapsed and crowded up under the clavicle.

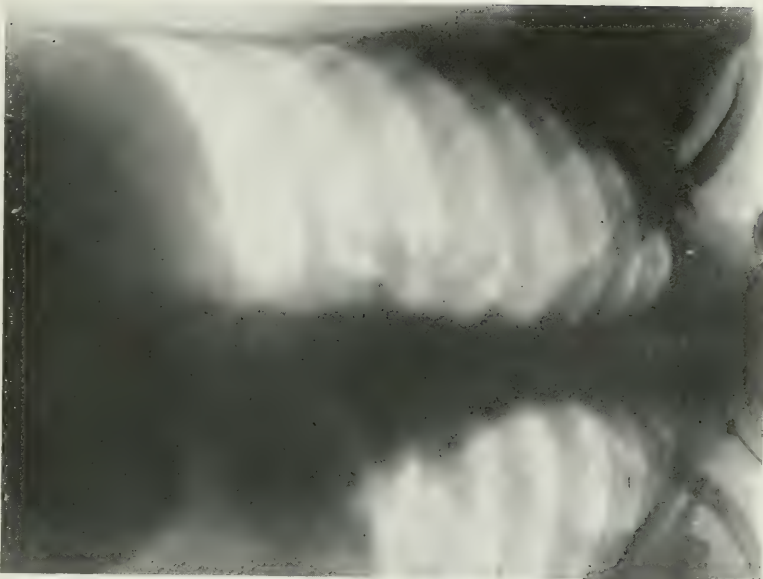


FIG. 6.—X-ray showing expanded lung filling left thoracic cavity. Picture taken three months after operation.

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Temperature, 99°; pulse, 76; respirations, 20. Abdomen generally tender, but marked tenderness and rigidity definitely localized over McBurney's point. Leucocyte count of 16,000. With a seemingly definite history of former attacks and in the presence of positive physical

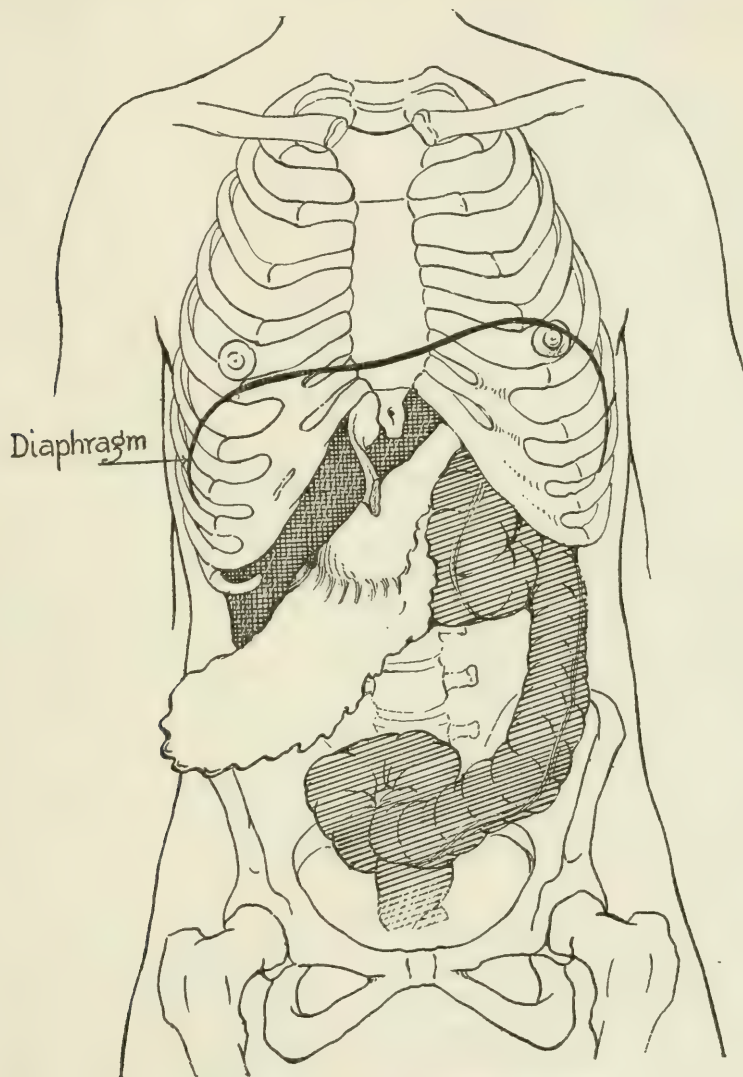


FIG. 4.—Relative height of repaired diaphragm.

and clinical findings, a diagnosis of acute appendicitis was made. Operation was accordingly advised.

Routine examination of the chest, made prior to operation, was recorded on the chart as follows: "Heart and lungs normal. Heart sounds somewhat indistinct."

A muscle-splitting opening showed the presence of a large amount of peritoneal fluid. Exploration demonstrated a ptosis of both the liver and the stomach. The lower edge of the right lobe of the liver was directly over the McBurney incision. An area, three inches in diameter, on the anterior surface of the liver, was whitish and studded with what appeared to be tubercular nodules. This, with the presence of an abnormally large amount of peritoneal fluid, led to a diagnosis of tubercular peritonitis. All efforts to find the appendix, cæcum, ascending or transverse colon failed. Further exploration was deemed inadvisable.

The patient made an uneventful convalescence and returned to her work in one month's time. In the meantime, however, an X-ray examination was made to determine the position of the appendix. It was then discovered that most of the large bowel and a large part of the small intestine passed up through the left dome of the diaphragm, filling the left chest and displacing the heart to the right. The left lung was almost completely compressed up under the clavicle.

Shortly after returning to work the patient had a few mild attacks similar to those that she had had before operation. On September 26, 1920, she noted that her abdomen suddenly became smaller by at least two inches. On September 27th, one day later, she began having abdominal pain with nausea and vomiting. Her condition persisting, operation appeared to be the only logical hope for permanent relief.

On October 1, 1920, under ether anæsthesia, a long left rectus incision was made, exposing the left dome of the diaphragm. A hernial opening three inches in diameter was observed through which passed the large and small intestine. At the lateral and outer border of the opening well-formed adhesions were separated and the thorax was emptied of its herniated contents by manual reduction. The right hand and arm of the operator were passed up through the diaphragm and the intestines dragged down and out of the chest. The pillars of the hernial opening were then sutured together with interrupted catgut. The line of suture was reinforced by attaching the base of the mesentery of the small intestine to the repaired area. Because of the patient's condition no attempt was made to remove the appendix or attach the large gut in its normal position.

Although convalescence was stormy for the first few days, the temperature never went higher than 99.6° . The wound healed by first intention and the patient was discharged twenty-two days after operation.

A three months' rest was advised. Work has been resumed and to date patient has been in the best of health with no return of abdominal pain. She has gained eight pounds in weight and states that she feels perfectly well.

Dr. A. C. Christie renders the following report three months after operation: "Examination of the colon on this date after administration of barium enema shows the colon to be entirely in the abdominal cavity. The left dome of the diaphragm is much higher than usual. The cæcum appears to be in the upper left quadrant of the abdomen. The left

lung appears to have expanded so that it fills the chest." Physical examination of the chest by Dr. B. M. Randolph confirms the X-ray findings relative to the left lung.

Because of its unusual pathology and undetermined etiology this case is of interest. The etiology rests between a possible congenital diaphragmatic defect or an acquired rupture as a complication of severe pertussis.

HEPATICODUODENOSTOMY FOR INJURY OF THE BILE DUCTS DURING CHOLECYSTECTOMY

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It is the general experience that injury of the common and hepatic ducts is usually the result of operative accidents. Since the operation of cholecystectomy has come, in a great measure, to supplant that of cholecystostomy, there has been a corresponding increase in the number of patients presenting themselves suffering from injuries to the bile passages. In only a small percentage of these cases will the accident be recognized at operation: the great majority presenting themselves some weeks or months later on account of a permanent biliary fistula, jaundice, or some other symptom of obstruction. It is a noteworthy fact that these surgical disasters are by no means limited to cases operated on by the novice, accidents of this nature having been reported by such men as Mayo,¹ Doyen,² Moynihan,³ Kehr,⁴ and others. Out of six cases of operative injury to the bile ducts during cholecystectomy that have recently come under my observation, the operations at which the accidents occurred had been performed by men of large experience in all cases but one. I still have a vivid recollection of assisting a surgeon of good repute and wide experience to do a cholecystectomy when about three-quarters of an inch of the hepatico-common duct was excised. Traction on the cystic duct had resulted in the clamp being placed on the drawn-up, angulated portion of the hepatico-common duct instead of the cystic duct. Fortunately the accident was noticed at the time and the defect repaired over a "T" tube with a good functional result.

These injuries to the bile ducts are mainly due to the failure of the operator to identify the cystic duct, and this is primarily the result of a poor exposure of the operative field. If an ample incision, preferably of the Bevan⁵ type, is made, the right lobe of the liver dislocated downwards and brought out through the wound, and the duodenum drawn gently to the left by an assistant, a good exposure will usually be obtained. In a few cases it may be necessary to place a gauze compress between the superior right lobe of the liver and the chest wall, as recommended by Masson,⁶ to bring the field into view. Then if the dissection is begun from below, while the field is still free from blood, there is little excuse for injuring the ducts. In some instances the injury may be due to hemorrhage from the cystic artery, the operator grabbing blindly into the space where the vessel has retracted, with heavy cutting forceps. Anatomical variations in the ducts and vessels, as reviewed by Eisendrath,^{7,8} and Gosset,^{9,10} may also be mentioned as a contributory cause of damage to the bile ducts, though the danger from these

anomalies would be inconsiderable if a proper exposure was obtained and the ducts identified.

While the removal of a gall-bladder is usually a simple surgical operation, reconstruction of the bile passages, perhaps weeks or months after the injury has occurred, is a formidable procedure. Moreover, the surgeon may succeed in establishing a passage-way for the bile from liver to intestine, only to find that obstruction recurs from cicatricial contraction in a few weeks or months.

Three clinical types of cases, the result of operative injury during cholecystectomy are met with:

(1) The case of biliary fistula with clay-colored stool, the condition being continuously present since operation.

(2) The case in which the patient becomes deeply jaundiced immediately following the operation, with little or no discharge of bile in the stools or on the dressings. Later a biliary fistula usually develops.

(3) Cases which do quite well after the operation, excepting that the discharge of bile through the drainage keeps up longer than usual. All goes well until some weeks or months after the fistula closes, when the patient develops jaundice, slight at first and intermittent, later tending to become deeper and more permanent. There is general skin pruritus with perhaps fever of low degree during exacerbations.

Regarding the nature of the injury, there may be stricture due to crushing or ligation, or the duct may have been divided or a portion of it resected. The stricture or defect is usually from one to two centimetres in length and is located at or near the point of entrance of the cystic duct.

The subject of operative injuries to the bile passages and methods for their repair has been well presented in very excellent articles by Mayo,¹¹ Jacobson,¹² Sullivan,¹³ Walton,¹⁴ Elliot,¹⁵ and others.

The type of operation employed in each particular case will depend on the extent and location of the injury, and in some cases on the condition of the patient. If one is successful in locating the duct above and below the obstruction and sufficient tube is available to bridge the defect, the operation of choice is an end-to-end anastomosis over a rubber tube, reinforcing the union with omentum. Where the lower segment of the duct is utilized the normal papillary entrance into the duodenum is preserved, and the danger of regurgitation of intestinal contents into the bile ducts and ascending infection of the bile tract and liver is avoided.

When the length of the damaged area is so great as to preclude the possibility of bringing the two ends of the duct in contact, the defect may be bridged with omentum over a rubber tube as worked out experimentally by Sullivan.¹⁶ This method has the disadvantage that it does not insure a mucous-lined tube and tends to become stenosed.¹⁷

While the presence of bile in the proximal end of the injured duct usually makes its identification easy, great difficulty will frequently be experienced in locating the distal portion. In some of these cases the physical condition of the patient will not allow of a prolonged search, and it will be considered good

surgical judgment to implant the stump of the hepatic duct direct into the duodenum. Hepaticoduodenostomy, as performed in the case here reported, carries with it the possibility of regurgitation of bile into the bile ducts and ascending infection of the bile passages and liver. The common hepatic duct from its origin from the right and left hepatic ducts in the transverse fissure of the liver, to the point where it is joined by the cystic duct, measures two and a half centimetres in length.¹⁸ In performing the operation of hepaticoduodenostomy the operator seldom has more than one and one-half centimetres of duct above the obstruction for purposes of anastomosis. With a stump of hepatic duct little greater than a centimetre in length, the "physiological" implantation of Coffey¹⁹ is impractical, and to attempt to carry out the principle by passing a rubber tube obliquely through the duodenal wall (Witzel) is of doubtful value. All methods of valve construction at the entrance of the bile duct into the intestine lack the normal sphincter control, and I have been unable to find any evidence in the literature that would indicate that the results obtained in cases where methods of this type were used, were better than where a direct implantation was made without any attempt at valve formation. That an individual can remain in perfect health indefinitely after a direct implantation of the hepatic duct into the duodenum, is shown by the case of Mayo,²⁰ the patient remaining well after fifteen years.

Duodenal fistula, with peritonitis from leakage of intestinal contents, or death from starvation is a grave complication that may follow hepaticoduodenostomy. This serious complication occurred in my case, though fortunately the patient recovered.

In some cases on account of the serious condition of the patient, it will be considered advisable to do the operation in two stages. At the preliminary operation the duct above the obstruction is drained, and when jaundice has disappeared and the patient has sufficiently improved, the second operation to reestablish the flow of bile from liver to intestine may be undertaken.

AUTHOR'S CASE.—Miss B., aged twenty-three years, had her gall-bladder removed at another hospital in January, 1918. For five months following the operation she had a biliary fistula and clay-colored stools. One year after the fistula closed she began to have increasing discomfort in the right upper quadrant, some general pruritus, and noticed that her skin and conjunctiva had at times an icteric tint. This condition gradually increased in severity, and in August, 1920, her stools were clay-colored for four days. Three months later she had a similar attack lasting a week, and these attacks at varying intervals have recurred to date. The pain in the upper abdomen has also increased in severity. The itching of the skin is now continuous and intolerable. She has not worked since her gall-bladder was removed.

Operation, March 11, 1921. The old operative scar was excised. The liver and omentum were found densely adherent to the anterior abdominal wall. The liver, transverse colon, omentum, stomach, duodenum and bile ducts were a dense tangle of adhesions. Landmarks



FIG. 1.—Stump of hepatic duct dissected free from adhesions. Stay sutures placed in position. Notice the absence of the gall-bladder.



FIG. 2.—Stay sutures tied. Stab made in duodenum and posterior row of stay sutures placed and tied.



FIG. 3.—Rubber tube shown with lower end in duodenum and upper end fixed in hepatic duct with suture of chromic catgut. Through and through sutures continued anteriorly.



FIG. 4.—Anastomosis completed. The insert shows the method of placing the lateral sutures to bring up an anterior and posterior fold, thus bringing a broad peritoneal coated surface of intestine in contact with the lower end of the duct and forming at the same time a papillary entrance for the duct into the duodenum.

were obliterated; the foramen of Winslow closed. The dissection was carried down carefully along the under surface of the liver. In doing so the liver capsule was lacerated, causing troublesome bleeding. The hepatic duct was identified and explored. Its distal end was lost in a mass of dense scar tissue. The stricture was impervious to the finest probe. Efforts to identify the duct below the stricture were unsuccessful and it was thought better to implant the hepatic duct direct into the duodenum than to endanger the life of the patient by a prolonged search which might ultimately end in failure. An hepaticoduodenostomy was then performed as follows: The stump of the hepatic duct was freed from its surroundings for one-quarter of an inch. Owing to the position in which the duodenum was adherent, it was possible to bring the end of the duct in contact with it, at a point suitable for anastomosis, without disturbing its posterior adhesions. The duodenum, at a point about two inches beyond the pylorus, was caught with three stay sutures, plain catgut, and fastened to the scar tissue posterior to the hepatic duct (Fig. 1). A stab was made through all the coats of the intestine, and a row of interrupted sutures of No. 00 chromic catgut were passed from the mucous surfaces through all the coats of both duct and intestine, uniting about one-half the circumference of the duct with the opening in the duodenal wall (Fig. 2). A rubber tube large enough to fit loosely in the hepatic duct was passed through the opening in the duodenum, and its upper end fastened in the end of the duct with a suture of chromic gut. The tube projected into the duodenum for a distance of three inches and was perforated with a terminal and a lateral eye. The row of sutures were then continued anteriorly, uniting the remaining half of the duct with the duodenal opening (Fig. 3).

The duodenum on each side of the anastomosis was then caught with three interrupted catgut sutures as shown in insert Fig. 4. These sutures when tied formed an anterior and posterior fold, bringing a broad surface of peritoneal-covered intestine in contact with the lower end of the duct, and also forming a papillary entrance for the duct into the duodenum. A rubber tissue drain placed down to the site of the anastomosis was brought out through the upper angle of the wound, and the abdomen closed.

The patient reacted well, and progressed favorably without leakage for four days. Then suddenly, for some unknown reason, she became violent, getting out of bed and behaving generally in an insane manner. Two attendants were required to restrain her. The following day there was a discharge of bile on the dressings, and on the second day after her escapade the dressings were soiled with duodenal contents also. The opening in the duodenum rapidly enlarged and in a few days practically everything taken by mouth passed out the fistulous opening. She was put on saline and nutrient enemata per rectum and given nothing by mouth. She lost flesh in a most alarming manner. However, the duodenal fistula closed spontaneously in three weeks. A week later bile appeared in the stool and a few days afterwards the biliary fistula

closed. She gained rapidly in weight and strength and was discharged from the hospital on May 5th.

At the present time (eight months after the operation) she is back at her work, feeling well. She has had no return of jaundice or pruritis. The wound is well healed and the scar healthy. Though instructions were given to have all stools examined, the rubber tube used in making the anastomosis was not found. X-ray examination, however, three months after the operation, showed it to have passed from the gastro-intestinal tract.

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ACUTE PERFORATED ULCER OF THE STOMACH OR DUODENUM

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ACUTE rupture of the stomach or duodenum is generally recognized as a serious surgical indication for immediate hospital attention. The treatment received after admission varies with the operative methods of the respective surgeons under whose care the cases are placed. Twenty-four cases were admitted under the department of surgery during the past five years, *all* of which were operated upon by some one of six members of the attending staff by the simple practice of inversion and drainage. The fact that these operators, of varying ages and experience, used the same method for gastro-duodenal perforation and secured uniform results lends additional weight to the value of the method. Of these patients, with the single exceptions of one two-day and one three-day ruptures, all survived. These results give an operability for acute perforation of ninety-two, an operative mortality of none, and a total mortality of 8 per cent. No case was denied the chances of operative recovery even if the probability of survival were against him. Very good results have been reported by others on selected cases by the combined method of inversion and gastro-enterotomy. It is the purpose of this study to present the above cases in outline together with the rationale of inversion, only, for perforation.

The ages, sexes, and nationalities of the respective patients appear on the accompanying table. Aside from these possible predisposing factors of ulcers, no further observations will be noted at this time on the etiology of ulcer.

The location of these ulcers is represented diagrammatically by the dark shading for the most frequent site of occurrence and by the light lines for less common sites, see Fig. 1. All but one are found on the anterior surfaces of the oral one and a half inches of the duodenum and pyloric end of the stomach and 76 per cent. at the anatomical pylorus or within a distance of two inches of the sphincter. The one posterior rupture appears on the first part of the duodenum. The size of the callosity varies from a palpable hardening to an involvement of the whole pylorus and adjacent gastric and duodenal walls; the perforations from that of a pin's head to one and a half centimetres in diameter. Often the typical findings are the abnormal amount and alimentary character of the free fluid and gas within the peritoneal cavity and the evidence of irritation caused by contact of the stomach's contents with the peritoneum. Occasionally a high-pitched blowing sound is encountered

upon opening the belly. This hissing sound, due to the stomach's driving of gas and fluid through the rupture, varies with the size of the opening and with the tone of the stomach. The extent of soiling and the degree of peritonitis vary with the size of the perforation, the contents of the stomach, the motility of the stomach, and the length of time elapsed after rupture. Occasionally with small ruptures along the lesser curvature and on the posterior wall the contamination is taken care of by adhesive formation which converts an otherwise acute break into a subacute or chronic perforating

Table Covering the Acute Perforations of the Stomach or Duodenum Admitted and Operated upon during the past Five Years (1914-1919.)

No.	Name	Date Adm.	Age	Sex	Nationality	Duration of Prev. Hist.	No. Hrs. Elapsed	Surg.	Result
1	R. W.	4-29-14	26	F.	Russian	2 wks.	6	S.	Cure
2	I. N.	5-12-14	35	M.	Russian	8 yrs.	4	C.	Cure
3	T. O.	2-10-15	39	M.	Italian	2 wks.	48	S.	Fatal
4	M. S.	7-21-17	37	M.	Italian	?	2	S.	Cure
5	B. K.	1-3-17	28	F.	Irish	?	24	F.	Cure
6	R. H.	3-17-17	24	M.	U. S.	?	4	S.	Cure
7	J. C.	3-26-17	42	M.	U. S.	?	72	W.	Fatal
8	A. C.	3-29-17	27	F.	U. S.	3 yrs.	7	W.	Cure
9	R. B.	3-31-17	37	M.	Irish	?	22	S.	Cure
10	L. W.	6-4-17	27	M.	U. S.	1 wk.	8	W.	Cure
11	M. S.	7-10-17	45	M.	Austrian	?	6	D.	Cure
12	C. O.	8-25-17	46	M.	Sweden	2½ yrs.	24	H.	Cure
13	F. O'C.	9-22-17	36	M.	Irish	4 wks.	6	D.	Cure
14	M. B.	8-31-17	51	F.	Irish	?	?	S.	Cure
15	M. G.	10-19-17	?	M.	Hebrew	?	3	S.	Cure
16	P. H.	1-5-18	55	M.	Irish	?	6	S.	Cure
17	P. C.	11-24-18	54	M.	Irish	?	6	S.	Cure
18	R. G.	2-20-18	?	M.	Italian	?	4	C.	Cure
19	R. M.	6-15-18	24	M.	U. S.	5 yrs.	2	B.	Cure
20	C. P.	12-7-18	30	M.	?	2 yrs.	3	B.	Cure
21	H. H.	12-9-18	25	M.	Russian	2 mos.	5	B.	Cure
22	L. P.	3-25-18	31	M.	U. S.	5 yrs.	12	B.	Cure
23	W. G.	6-8-18	19	M.	U. S.	2 wks.	8	B.	Cure
24	M. H.	6-17-19	23	M.	U. S.	0	6	B.	Cure

NOTE.—The letters S., D., W., F., and B., designate the operators: Stewart, Douglas, Cramp, Wadham, Foskitt, and Barber, respectively.

ulcer. The liver, gastrohepatic omentum, pancreas, and rarely the transverse colon have been found in such instances the important barriers against free soiling. The frequency of concealed perforation represented by some is not borne out by the statistics of Symmers from the autopsy records of Bellevue Hospital. In this series, excluding two moribund cases of forty-eight and seventy-two hours, respectively, three individuals present themselves between twenty and thirty hours after rupture and the remaining nineteen before twenty hours, making an average of eight hours. In most instances the colon bacillus has been recovered from the peritoneum, in one individual, six hours after the onset of the acute pain, which probably marked the occurrence of the pyloric rupture. The streptococcus and staphylococcus have been less frequently found. Although the colon organism has been recovered from the presumably normal stomach, experimentally, it is

probably true that the peritonitis met with in the earliest hospital cases is non-infectious.

The pathology explains the sudden onset of agonizing upper abdominal pain with prostration, the board-like rigidity and exquisite tenderness, the hissing sound, if present, of gastric emptying through the rupture, and the polyneucleosis. It is important to observe the sudden onset of dyspnœa, the rapid costal breathing, and the sharp pain whenever the diaphragm is thrown in. Pneumonia, pleurisy, tabes, gastric dilation, gastroduodenitis, the lead colics, etc., should be excluded. Other conditions which have presented themselves for differentiation are influenza, pneumococcus peritonitis,



FIG. 1.—Diagram representing by dark and light shading the more and less frequent locations of perforated ulcers of the stomach and duodenum.

acute hemorrhagic pancreatitis, perforative cholecystitis, ruptured appendicitis, and mesenteric thrombosis.

Influenza, occurring during the fall and winter, may present extreme abdominal pain and rigidity while the local tenderness does not remain as definitely epigastric. Distinguishing points should appear in the history. One individual, complaining of pain in the lower left quadrant and presenting rigidity and tenderness in the upper right quadrant, disclosed, at operation, a thin sero-fibrinous exudate on the hepatic flexure and leaves of the meso-sigmoid and developed broncho-pneumonia two days post-operative.

Pneumococcus peritonitis occurred in one instance in an adolescent male without history and without signs of lung involvement either before or after operation. There were sudden onset of abdominal pain, vomiting, and generalized peritonitis. In this particular case the "terminal ileum contained lymph follicles which stood out visibly and lymph-nodes in the mesentery of the terminal ileum, measuring 2 to 5 cm. in longest diameters." The pneumococcus was recovered from the exudate and from the appendix. Recovery followed appendectomy.

In acute hemorrhagic pancreatitis, the individual resembles the gall-bladder type of patient and often gives a history and symptoms suggestive of cholecystitis. The pain is severe, the tenderness epigastric and right lumbar, and both are far out of proportion to the rigidity, which is not very marked.

Perforative cholecystitis in the early hours is characteristic of gall-bladder disease, when general peritonitis has developed it may be impossible of differentiation. The same is true of acute appendicitis which should be suggested before peritoneal involvement by appendical skin hyperalgesia.

Mesenteric thrombosis occurred once in the hospital series in a Bohemian of forty, who gave a history of abdominal pain and vomiting for one day and generalized tenderness and rigidity. Operation revealed obstruction well up in the mesenteric vessels and total gangrene of the small gut. In this instance the rigidity was marked, but the most tender point appeared to be below the umbilicus.

The operative methods recommended, include excision, inversion, gastro-enterostomy, pyloric occlusion, and combinations of these. Excision and pyloric occlusion are of theoretical interest only; inversion with or without gastro-enterostomy is the operation of choice.

In the present series inversion and drainage, with or without plication and omental grafting, have been the rule of practice. Gastro-enterostomy was not performed in a single case. This treatment is as follows: Each perforation upon entering the surgical ward is gone over by the house staff and prepared for immediate operation. Urine, blood, and blood-pressure are examined and, after diagnosis, morphia is administered to allay shock. In the proper cases transfusion is arranged for. The incision is upper right rectus; in the doubtful cases an opening may be made at the umbilicus and enlarged upward or downward as the indications warrant. To further combat shock, the intra-abdominal work is made as speedy and as accurate as possible and all peritoneal traumata are kept at the minimum. Cleansing of the peritoneum is accomplished by removing with forceps any coarse food particles that may be present and by aspirating the surplus fluid with a sucker. The stomach and duodenum are mobilized by holding conveniently in moist gauze pads while the ulceration is inverted by one or more purse-strings or by interrupted Lemberts of chromic gut. In the extensively indurated ulcers, the duodenum is freely plicated over the pyloric end of the stomach. When practicable, the omentum is tacked over the site of inversion. Drainage is based upon the extent of peritoneal soiling; *in situ* cigarette drains are used in every case, upper right lumbar drains through stab wounds in selected cases, and, in the majority of individuals, additional pelvic drains are left in the lower angles of the abdominal wounds. In the one exception in which no drainage at all was instituted, the patient poured out excretions from between the sutures. Cultures are taken, and all wounds are closed in layers with interrupted sutures.



FIG. 2.—Control, one day after ether anæsthesia and laparotomy. Note distended stomach and duodenal cap. (Exp. No. 25.)



FIG. 3.—Control one day after ether anæsthesia and laparotomy. Note—Stomach empty 5 hours after bismuth meal with head of column in colon and tail in ileum.



FIG. 4.—Pyloric perforation 3 days post-operative. Note stomach and obstructed "cap." (Exp. No. 90.)

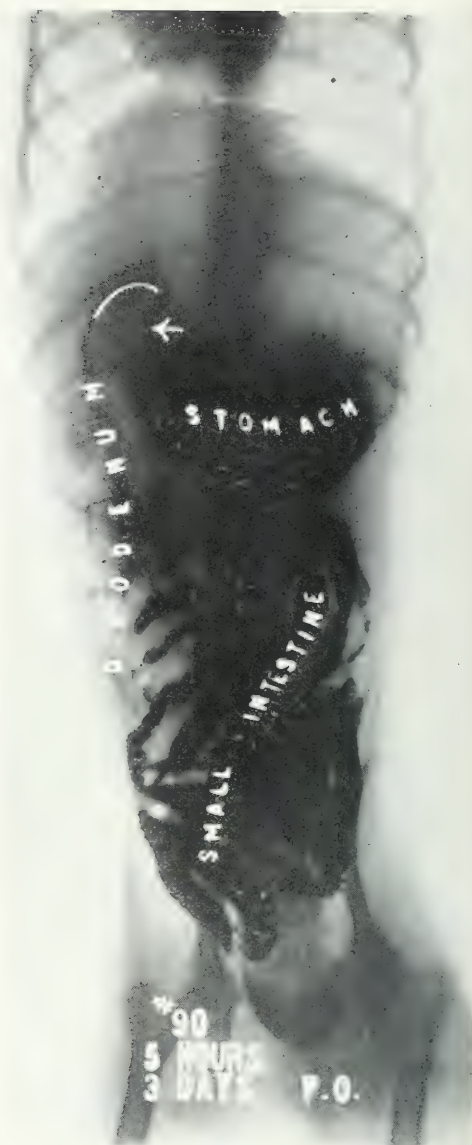


FIG. 5.—Pyloric perforation 3 days post-operative. Note—5 hours after bismuth meal; residue in stomach, duodenum and small intestine; head of column in sigmoid (not labeled on print but seen lying caudad of mass of small intestine).

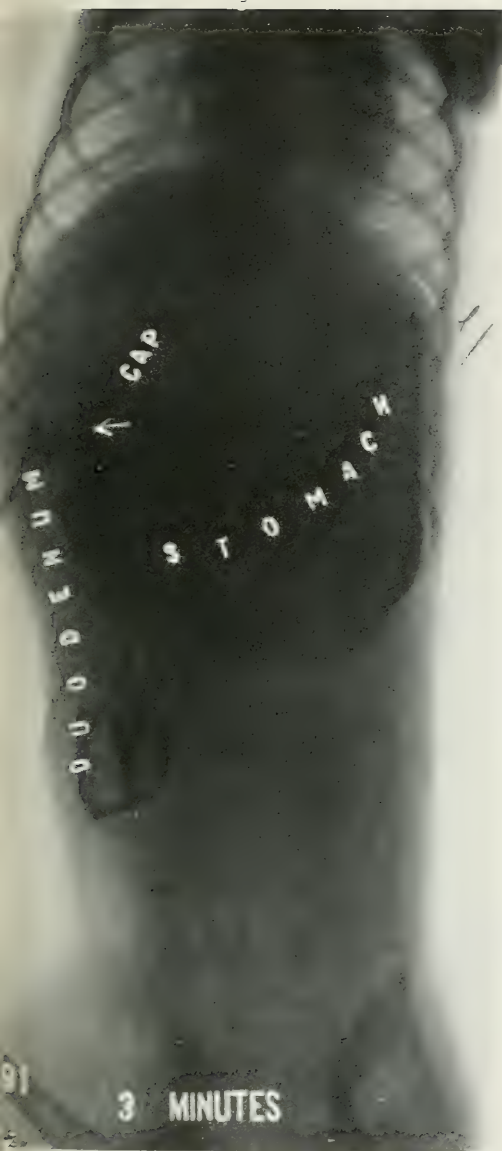


FIG. 6.—Pyloric perforation 4 days post-operative. Note—stomach obstructed "cap" and duodenal filling. (Exp. No. 91.)



FIG. 7.—Pyloric perforation 4 days post-operative. Note—5 hours after bismuth meal, empty stomach; column with head in descending colon and tail in ileum. (Exp. No. 91.)

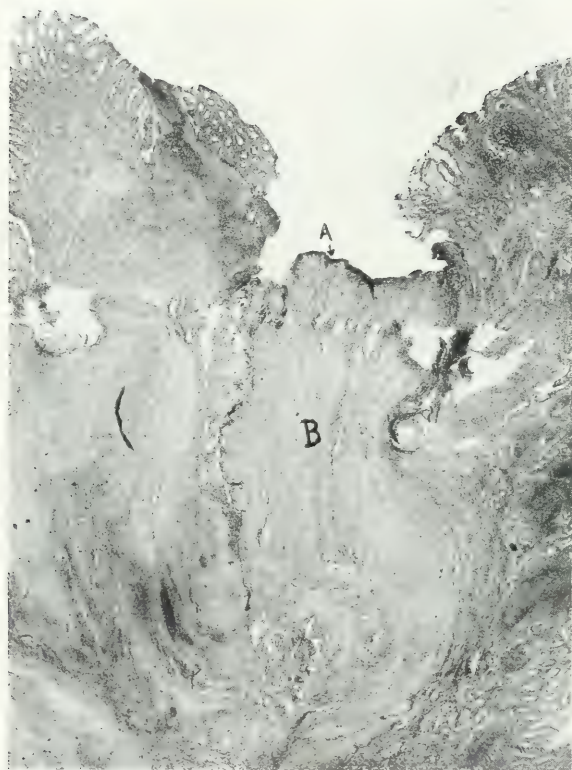


FIG. 8.—Microphotograph of healing 3 day perforation. Epithelium (A) is beginning to bridge in gap between edges of wound. Note fibrous plug of scar tissue (B).

The post-operative care is that of peritonitis. Most patients are placed in the Fowler position; selected cases are left prone or in the head-down position, depending upon the location and extent of peritoneal soiling. Fluids are supplied by rectum. Patients are kept warm by external heat and quiet by the use of morphia, if necessary, for the first forty-eight hours. The time of feeding depends upon the patient's desire for food, for the onset of the patient's hunger contractions seems to be the most dependable guide. Most of these crave water, which is given on the third day. Albumin water and milk are given in increasing quantities on the succeeding days until a fairly generous ulcer-diet is allowed at the end of three weeks. By this time the patients are up and about the wards ready for discharge to a convalescent ward, if possible, for by this means the diet and general care of the patient may be supervised for five to seven weeks, or, if this cannot be arranged, the convalescents are discharged under instructions to report for periodic observations in the follow-up clinic.

The complications in this series have been diaphragmatic pleurisy in one case, acute pneumonic phthisis in another, and delayed wound-healing requiring secondary suture in another. Every case was given a chance of operation including the two- and three-day cases, one of which, in spite of transfusion, died upon the operating table and the other soon after returning to the ward. All the remaining of the twenty-four cases recovered uneventfully.

The follow-up care of these patients has consisted, as far as possible, in keeping them under observation or in getting them to report by answer to questionnaire on their conditions. An analysis of replies covering the past one- to five-year cases shows that in most instances these people have returned to their former habits and occupations and that they consider themselves cured or satisfactorily improved. There is occasionally pyloric impairment enough to give a six-hour residue. There are "occasionally gas disturbances," "occasionally gas and pain," and in two instances "vomiting occasionally." Of these vomiting cases, one gained fifteen pounds and the other twenty pounds in weight. One individual who reported "occasional pain" and a gain in weight of sixteen pounds volunteered the information that he had pain "only after overeating." These reports compare favorably with the chronic ulcer cases upon whom gastro-enterostomies have been performed.

This method of treatment is two-fold; namely, that of the acute patient first brought into the hospital and that of the discharged patient during observation. The indications of the acute stage are taken to be closure of the perforation and drainage; those of the discharged patient, the possible appearance of surgical obstruction of the pylorus. To date there has been no secondary treatment, not because all the patients have been entirely symptom-free, but because no one patient would acknowledge that he was sufficiently uncomfortable to allow himself to be reoperated upon. This

experience corresponds with Gibson's New York cases and with the twenty post-operatives followed by Wright in Stewart's St. Vincent's cases.

The rationale of simple inversion for perforation as opposed to inversion with gastrojejunostomy is further borne out on the experimental stomach. Pyloric stenosis, present at the time of operation or thought likely to appear thereafter, is taken as the indication for anastomosis. Obstruction at the pylorus is believed of frequent occurrence after a plastic of the kind above described, but it is thought to be transitory in nature and to have largely disappeared by the time of onset of hunger contractions. To illustrate the repair of a perforation at the pylorus and the return of the pyloric canal to normal function after inversion, plication, and grafting, the stomachs of five dogs were perforated, closed, X-rayed, and sectioned.

Experimental Technic: The pyloric sphincter of each of five dogs is perforated by means of a cautery iron and closed by inversion by means of two purse-string sutures, by plication of the duodenum across the anterior face of the pyloric end of the stomach, and by tacking the available omentum over the site of the inversion. In order to eliminate the gastric inhibition due to the ether anæsthesia and laparotomy, a control-animal was anæsthetized and a laparotomy performed exactly as in the case of each of the other animals but nothing whatever was done within the abdomen. The animal was given water by rectum and nothing by mouth as were all the animals. Each dog was given a 300 c.c. zoolack-bismuth emulsion and X-rayed for outline and emptying time. The control was X-rayed after one day, the perforations on the first to fifth days post-operative. After radiographing each of the five inversions, the stomach was removed, photographed, and the specimen microphotographed.

It is to be emphasized from the above technic that closure of the perforation is carried out so as to give the animal the maximum of protection against possible leakage without any idea of preventing pyloric obstruction. Under these conditions, clinically, pyloric stenosis might be considered probable and, for that reason, gastro-enterostomy might be indicated.

The behavior of these experimental stomachs corresponds with the clinical courses of human cases.

Röntgenological Findings: (Based upon radiographs by L. T. Le Wald, q. v. 2-7.) Stomachs distended with opaque meal in all. Hypermotility accounting for spontaneous initial emptying. Pylorospasm recorded in all the animals. Filling defects in pyloric portions or in duodeni of all, due to spasms or deformities. Five-hour retention in one-, two- and three-day dogs and complete emptying in four- and five-day animals. Control shows active motile pyloric part, "cap," and total clearance within the five-hour interval. The progress of the bismuth columns in the remaining intestinal tracts may be seen in part on the accompanying röntgenograms.

ACUTE PERFORATED ULCER OF THE STOMACH

From the X-ray standpoint the normal stomach may be expected to empty under the above experimental conditions in three and one-half hours, the stomach one day after an abdominal wound and anæsthetic shows retrostalsis (vomiting) and a one-hour delay, stomachs with obstructed pyloric outlets, as above described, develop hypermotility, including pylorospasms, during the first three days and hypermotility without obstructing spasms on the fourth and fifth days post-operative.

That this delay is, in part, purposeful or protective, appears from the gross and microscopical pathology (*Cf.* 8 and 9-13, author's notes).

Surgical Pathology (gross): Approximately six hours after the bismuth meals the stomachs of all five animals were examined. All appear fairly well contracted. The distorted pyloric ends and duodeni appear very much as left at operations but this distortion seems to have been somewhat overcome by a straightening out of the stomachs in the fourth- and fifth-day animals. After opening the stomachs the tips of the little fingers could be passed through the pyloric canals of the fourth- and fifth-day stomachs, but not through those one to three days post-operative. These findings correspond with the infolding which appears more evident during the first three days. The perforative wounds are tight and amply protected (microscopical). Fraser found the inverted edges in close contact in all, œdematous swelling in the one- to three-day specimens, and fibrous bridging and epithelialization in the later sections. (Fig. 8.)

It is believed that the letting-up of the gross mechanical obstruction, the microscopical repair, the disappearance of obstructive pyloric spasms, and the return of hunger contractions as early as the fourth and fifth days, emphasize the transiency of the stenosis resulting from inversion and plication.

SUMMARY

(1) This report is based upon twenty-four acute perforated ulcers of the stomach and duodenum coming under the department of surgery during the last five years.

(2) All were given a chance of operative recovery and with the single exceptions of one three-day and one two-day perforations all survived. The operative procedure in each instance was inversion and drainage with or without plication and omental grafting.

(3) Gastro-enterostomy has not to date appeared indicated in the subsequent courses of these patients. The rationale of inversion appears further borne out by a study of the surgical pathology of perforation in the normal stomach.

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BLIND-END CIRCULAR SUTURE OF THE INTESTINE, CLOSED ENDS ABUTTED AND THE DOUBLE DIAPHRAGM PUNCTURED WITH A KNIFE INTRODUCED PER RECTUM

BY WILLIAM STEWART HALSTED, M.D.
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THE last word on the subject of intestinal suture may some day be written, but surely not until much experimental work has been done with an exactness not hitherto contemplated in investigations of this nature. Authors of text-books and of papers lend their indorsement to some particular variety of suture without offering plausible argument for their preference other than a certain measure of success which has attended its employment in their hands; and faulty methods succeed so well that interest in the relative merits of the details of the various procedures has not been sufficiently aroused to demand greater precision in the experimentation and the critical analysis.

Who knows, for example, how much of the intestinal wall should be turned in; whether two rows of stitching are better than one; whether the suture should be continuous or interrupted; whether the Lembert or mattress stitch is preferable; if the knots should be on the mucous or on the peritoneal surface; why some stitch-loops (knots outside) fall into the lumen and others remain on the peritoneal surface; who has considered the factors facilitating or delaying the release of the intumescence; and who, indeed, has endeavored to estimate the weight of the burden thrown upon the experimentee to counteract the operator's shortcomings?

Assuredly there is no subject in surgery which has received experimentally a tithe of the labor devoted to intestinal suture. Lives there, indeed, a surgeon who has not made experiments in suturing the intestine—if not on animals, then on man?¹ Such performance on the human subject without rehearsal on animals is a ruthless play with human life, advancing knowledge scarce a tittle.

Last winter, at one of the monthly meetings of the Johns Hopkins Hospital Medical Society, Doctor Holman and the writer reported² the results

¹ In our laboratory operative courses for students of the Johns Hopkins Medical School the leading topic from the time of the introduction of these exercises in 1895 up to the present year has been intestinal suture. I embrace this opportunity to express my indebtedness to Harvey Cushing, for thirteen years my brilliant assistant, for his zeal in elaborating these courses and placing them on such a substantial basis that they are now regarded as one of the dominant features of the surgical curriculum for the third-year medical students at the Johns Hopkins University, and are being adopted by other medical schools of this country.

V. S. Halsted and Emile Holman: An End-to-end Anastomosis of the Large Intestine by Abutting Closed Ends and Puncturing the Double Diaphragm with an Instrument Passed Per Rectum. Johns Hopkins Hosp. Bull., 1921, vol. xxxii, p. 98.

of a few experiments having for their object the development of an end-to-end suture more nearly aseptic than had hitherto been devised. The bulkhead suture³ had taught me that without danger of resulting obstruction, the intumescence of intestinal wall (the flange) may be much greater than is generally supposed, so great indeed as quite to fill the lumen of the gut; and the highly instructive and too little known experiments of my former assistant, Dr. Willis D. Gatch,⁴ convincingly support this assertion.

In the course of the speculations, which eventually led to the development of the bulkhead suture, I had entertained and discarded the idea of trusting to the absorption of a catgut purse-string to reestablish the intestinal lumen occluded by the double diaphragm of abutted closed ends, and wrote of it as follows (*l. c.*, p. 217): "But a double diaphragm remains to impede for a long time the advance of intestinal contents even if the ligature employed in the tying off of the gut could be relied upon to melt away with the desired promptness." Evidently I did not realize at the time how great the intumescence might safely be. Later we ascertained that the amount inverted by the bulkhead method proved to be even greater than in the blind-end suture which it is the purpose of this communication to describe, and produced no obstruction nevertheless.

At the outset of the recent experiments outlined in our report to the Johns Hopkins Hospital Medical Society last winter, I had it in mind to seek a method which at least might be applicable to such cases destined for excision of the large intestine as had previously been provided with a colostomy. Doctor Holman and I found that dogs tolerated quite well what we believed to be a complete obstruction of the descending colon for four days or more, the time apparently required, as a rule, for the disintegration of the catgut (No. 0 doubled) purse-string ligatures with which the abutted blind ends had been closed.⁵

Soon after making our report it occurred to me to test the feasibility of dividing the purse-string ligatures, or at least of puncturing the double diaphragm by a protected cautery wire, or knife, or knives passed from below—per rectum. The cautery was soon abandoned, being considered dangerous and too complicated. The knives—at first one, later three, and finally four—housed in a short cylinder of wood or metal were tested. I believed in the beginning that the cylinder should approximately fill the bowel in order to centre the knife and thus insure the cutting of the purse-strings, but soon

³ W. S. Halsted: A Bulkhead Suture of the Intestine. *Jour. Exp. Med.*, 1912, vol. xv, p. 216.

Ernest G. Grey: Studies on the Aseptic End-to-end Anastomosis of the Intestine. *Johns Hopkins Hosp. Bull.*, 1918, vol. xxix, p. 267.

⁴ Willis D. Gatch: Aseptic Intestinal Anastomosis. An Experimental Study. *Journ. A. M. A.*, 1912, vol. lix, p. 185.

⁵ Unsterilized or "raw" catgut seemed to dissolve more quickly than the sterilized, but it was not so strong, and Nos. 1 and 0 would frequently break on the tying of the purse-string.

found that these cylinders might actually prevent the centring of the knives unless the stitches were precisely equidistant from the centre.

One knife proved to be better than three or four because (1) less force was required to cut the ligatures or perforate the diaphragms, and (2) one of the three or four knives (blades parallel and both edges of each knife sharpened) might engage the mucosa of the intestinal wall at the margin of or just below the intum.

The Method.—The vessels supplying the portion to be excised are occluded by fine transfixion ligatures carried by milliners' needles, and are divided as shown in Fig. 1. Strong Kocher clamps are applied, one at the distal, the other at the proximal end of the piece deprived of its circulation. Along the proximal edge of the mark made by the proximal clamp, and along the distal edge of the mark of the distal clamp, a finely basted purse-string stitch of silk^a is run with a milliner's needle; these ligatures are drawn home and only a half knot taken in each; the knots are completed at the moment the intestine has been divided with the electric cautery wire. Prior to the burning, stout threads are tied about the isolated segment at a suitable distance from the basting stitches (Fig. 2). The purse-strings can be drawn tighter after the tension caused by the encircling threads has been relieved by the severance of the gut. After the burning, the little overhangs, which may at the discretion of the operator be further sterilized chemically or by the electric wire, are trimmed with scissors as close as feasible to the purse-strings. It is hardly possible to cut these threads in the trimming process, and hence, without fear, one snips the little teat of everted bowel wall completely away (Fig. 5).

For the suturing, a single row of mattress stitches suffices. The first five of these (stay stitches), drawn home and tied, facilitate the introduction of the others and serve as guides to their proper placement. The order in which the stitches have usually been taken is shown in Figs. 6, 7 and 8. The two at the mesenteric border are placed a little closer to each other (Fig. 7, insert) than the remainder, and are the first to be tied.

The suturing having been completed, the dog is drawn down until his buttocks overlap the edge of the operating table. An assistant then introduces per rectum the instrument with which the purse-strings are to be cut. Figs. 10, 11, 12 and 13 depict the manœuvres so well that explanatory notes are hardly necessary. The purpose of the short piece of rubber tubing is to protect the sphincter from the sharp edges of the knife and to facilitate its introduction into the rectum. This tube is left in the position shown in Fig. 10 until the knife has been withdrawn.

The knife point, protected by a little piece of cork on the tip, is

^aSilk was used for the purse-strings to exclude the possibility of misinterpretation of the results. Were the purse-string ligatures of catgut one could not be sure that the restoration of the bowel's patency was due to the cutting of these ligatures and not to their dissolution.



FIG. 1.—Ligation of the blood-vessels by transfixion.



FIG. 2.—The marks made by the crush of the clamp serve merely to guide the placing of the finely basted purse-strings.

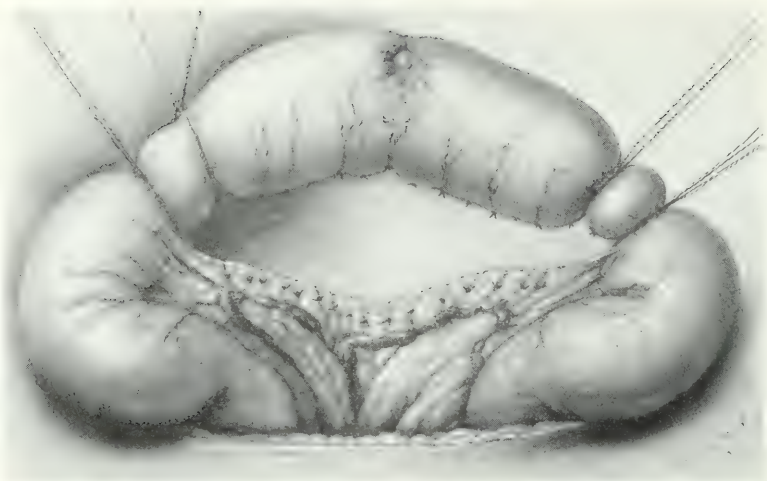


FIG. 3.—Purse-strings tied with half knots; stout ligatures on the piece to be resected.

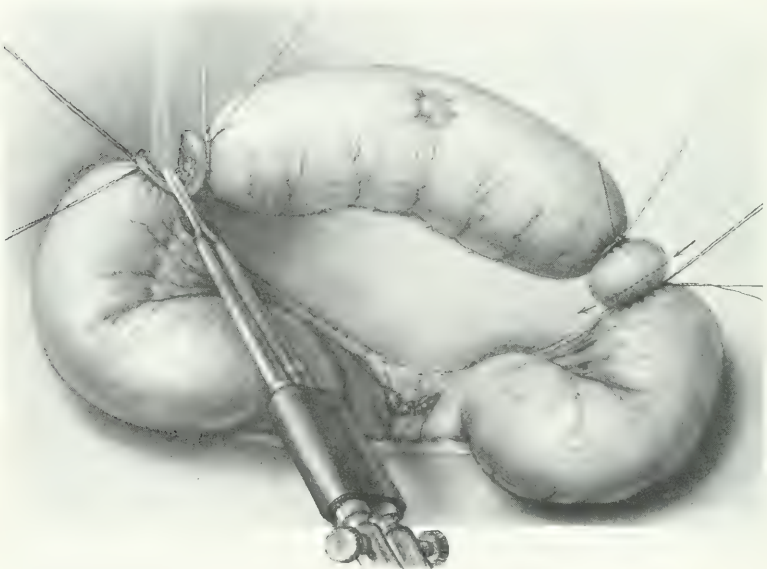


FIG. 4.—After division of the bowel with the cautery the purse-strings are tightened and their knots completed.

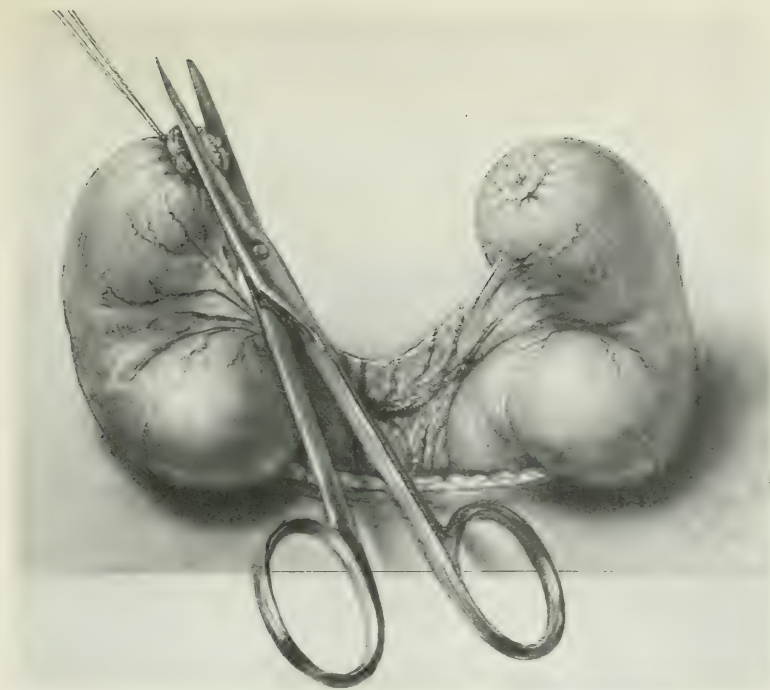


FIG. 5.—The overhang may be trimmed as close as possible without fear of cutting the purse-strings.

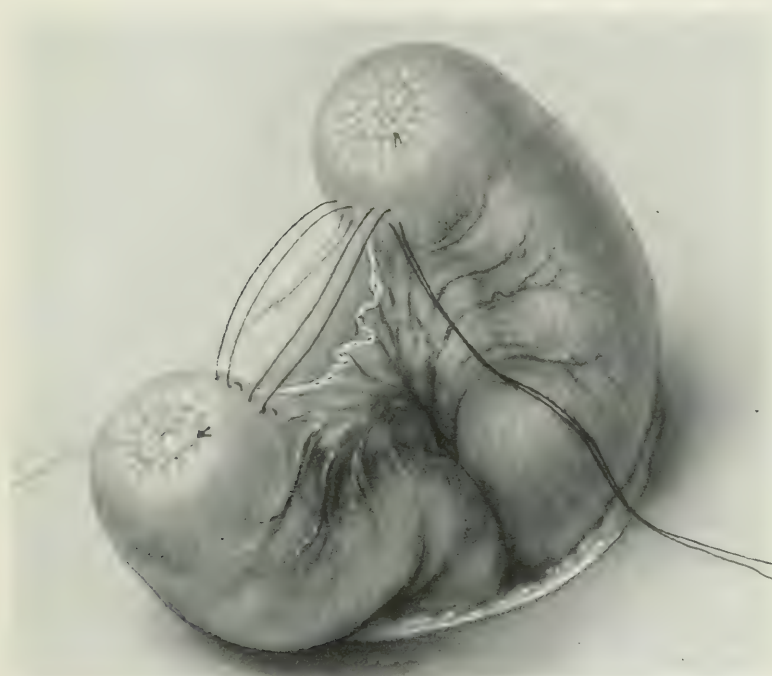


FIG. 6.—The first of the mattress stitches, one on each side of the mesenteric border.

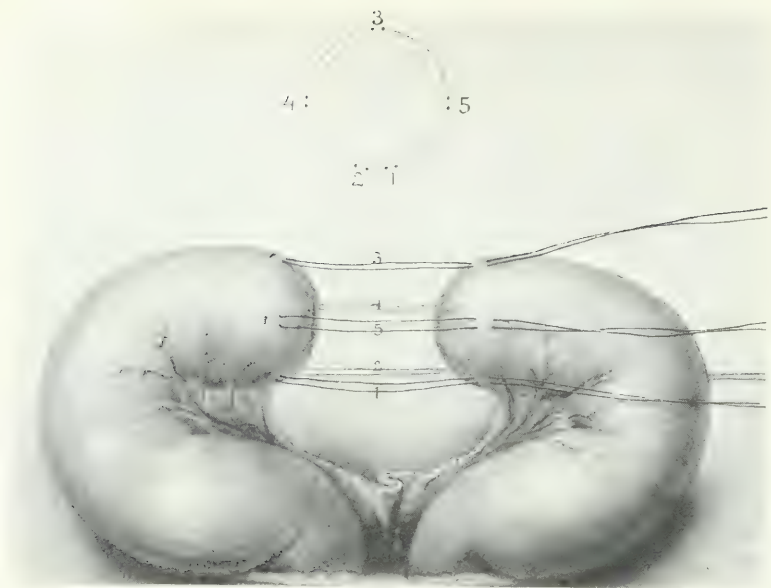


FIG. 7.—The five stay stitches; the numerals indicate the order in which they are taken.

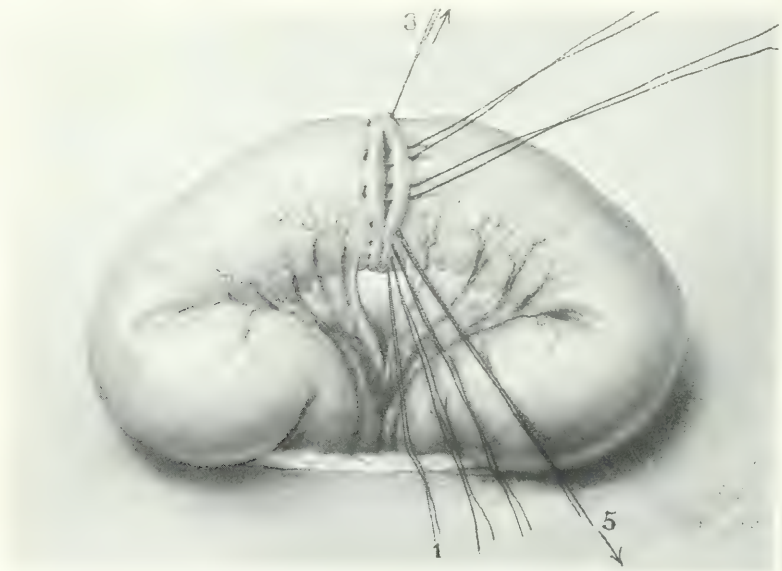


FIG. 8.—Traction on the stay stitches facilitates the taking of the intervening ones.

propelled to the required distance by the assistant who manipulates the flexible metal tail (gas tubing) of the instrument. With no more, or rather less, pressure than is required for the introduction of a stomach tube, the knife will glide along the dog's bowel to the ileocæcal valve. When the knife reaches a point in the pelvis easily accessible to the operator's hand it may be guided by him through the remainder of its course to the double diaphragm; but it rarely needs such guidance. The slightest obstacle to the progress of the knife is detected by the assistant in charge of its trailer or tail. The cork having been removed (Fig. 12), it is slid down the bowel and out of the way (Fig. 13). In making the thrust the operator grasps the metal tubing quite close to the shank of the blade and aims for the centre of the diaphragm, hoping thus to cut both of the purse-strings (Fig. 13). Whether these happen to be divided or not would seem, judging by the results, to be immaterial, nevertheless one should make two or three thrusts at slightly different spots, but all as near the centre as possible, in the endeavor to cut these ligatures. The more experienced the operator the better he can sense the greater resistance to the point of the knife offered by the tissues so tightly compressed by the purse-strings. As a precautionary measure a tapered bougie is passed through the diaphragm before closure of the abdominal wound (Fig. 14).

Forty-seven dogs have been operated upon by this method without a fatality and without symptoms indicative of an abnormal convalescence. The bowel resected was in every instance the colon. The operations were performed by my former and present assistants and myself, some of them by recent graduates of our school without operative surgical experience. The initial experiments were made with an extemporized instrument—a knife housed in wood and mounted on a brass rod. From the outset, however, it was our intention to have a flexible trailer in case the results with our crude apparatus seemed promising. Notwithstanding the defects of the unwieldy home-made instruments used in the earlier experiments and the lack of experience of several of the operators, not a single death occurred.

Hardly a year had passed since 1886 when with the assistance of Dr. Franklin P. Mall I made many experiments in intestinal suture,⁷ without further experimental investigation of this subject on the part of my assistants and myself. Not one of us (Gatch, Grey, Holman, Halsted) had a series of more than twenty-three dogs without a death. The present series; therefore, of forty-seven consecutive successes being the longest for our laboratory and, so far as I know, hitherto unequalled elsewhere, it would seem worth while to offer it to the profession for trial and criticism.

It will readily be conceded for this method that the amount of soiling

⁷ W. S. Halsted: Circular Suture of the Intestine—an Experimental Study. *Amer. Jour. Med. Sci., Phila.*, 1887, n. s. No. 188, p. 436.

F. P. Mall: Healing of Intestinal Sutures. *Johns Hopkins Hospital Reports*, Baltimore, 1896, vol. i, p. 76.

could hardly be less; it is little more than occurs in a simple, properly performed appendectomy.

For the first time therefore in the history of intestinal suture two of the factors, the soiling and the amount of inturn, have been reduced almost to a constant, and hence we are now better prepared to test on animals the relative merits of the various stitches in common use.

In operations on the human intestine the surgeon's only criterion has been the mortality; for one cannot explore the abdomen of his patient every few hours after operation in order to determine the amount of reaction (infection and adhesions) about the line of suture, the fate of the stitches, the depth of the inturn, the delay in its unfolding, etc.

Unembarrassed by soiling, or eversion of the mucous membrane, or the presence of a single clamp or other instrument, or by the fear that the mesenteric border may be imperfectly inverted, or that the amount turned in may be too great or too little, or that some point of a running stitch may have been too loose or too tight, the operator proceeds in orderly and uniform manner from the beginning to the end of the performance.

In addition to the two constant factors mentioned above—the amount of soiling and the amount turned in—it is possible, at least in experiments upon the dog, to have another constant factor, *viz.*, the depth to which the stitches penetrate. One may learn in a few minutes to sense the submucosa with the point of the needle and to include a part of it in the stitch without entering the lumen of the gut. With a little practice one learns not only to pick up a thread of the submucosa but to press the needle along in the plane of this coat. The resistance in the latter case may be so great as to remind one of that experienced in the taking of subcuticular stitches. Members of our upper surgical staff can all testify to the accuracy of this statement. And who will not assent to the view that it is desirable to take the submucous stitch when this is feasible? Experience has taught us that stitches which do not enter the mucous coat become ultimately subperitoneal loops, and long before the diaphragm or flange has unfolded. Uninfected, they are cast outwards, and not discharged into the bowel's lumen; whereas, the perforating stitches seem usually to ulcerate their way into the gut. We sometimes find one or more of these perforating stitches hanging in or near the line of suture even when the unfolding process is about complete—when little trace of the diaphragm remains. In the track of all of these stitches which are discharged into the bowel there has necessarily been an infected sinus from the moment of their placement until their release. Dr. Florence Sabin,⁸ in her elaborate and unique study of the healing of Doctor Holman's end-to-end anastomoses of the intestine, rarely found that a stitch had perforated; when this had occurred in ever so slight degree there was inflammatory reaction, sometimes a small abscess, about the silk thread.

⁸ Florence R. Sabin: Healing of End-to-end Intestinal Anastomoses with Especial Reference to the Regeneration of Blood-vessels. Johns Hopkins Hosp. Bull., 1920, vol. xxxi, p. 289.

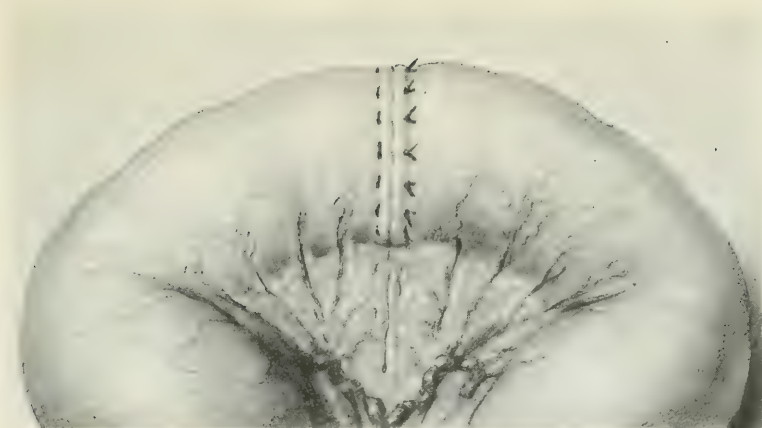


FIG. 9.—Suture completed.

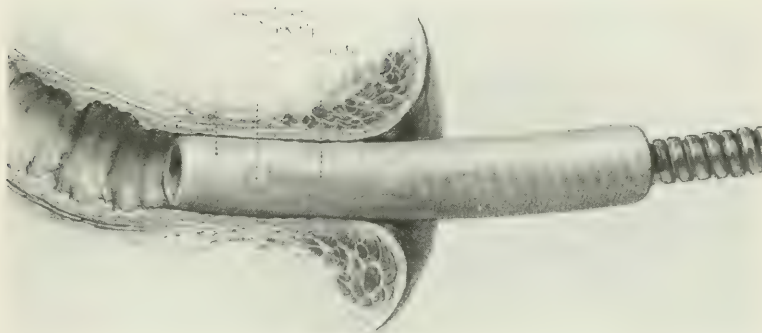


FIG. 10.—The knife in transit through the rubber tube which protects the sphincter.

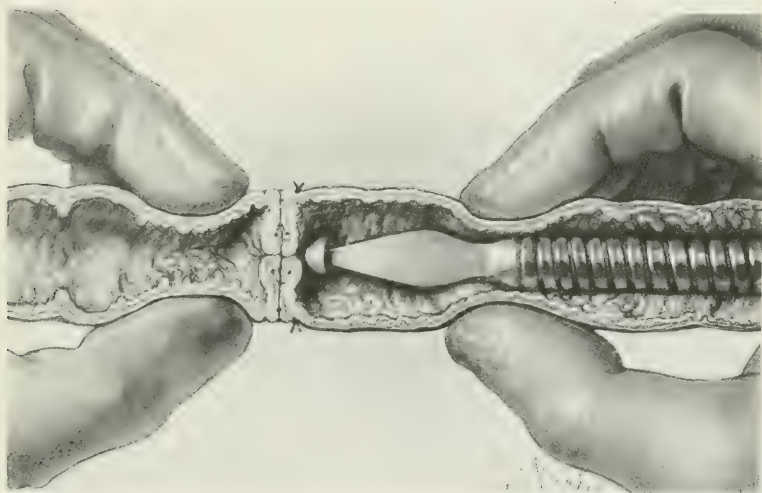


FIG. 11.—The knife has been pushed up to the diaphragm by the outside assistant.

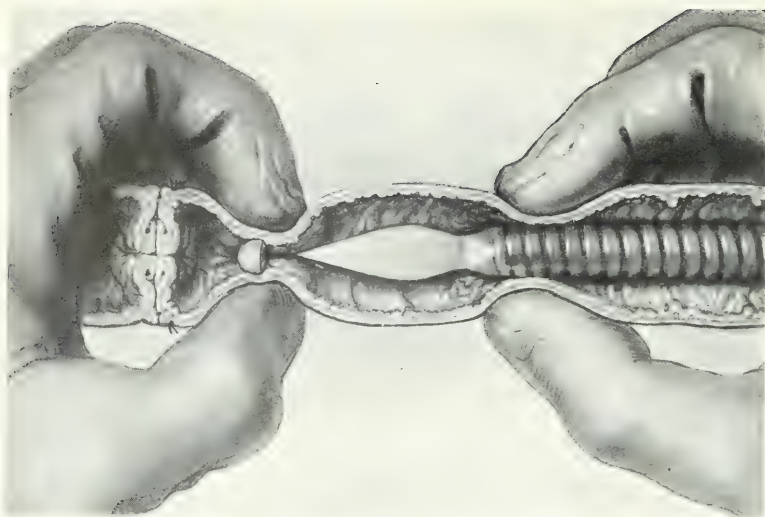


FIG. 12.—Removal of the cork.

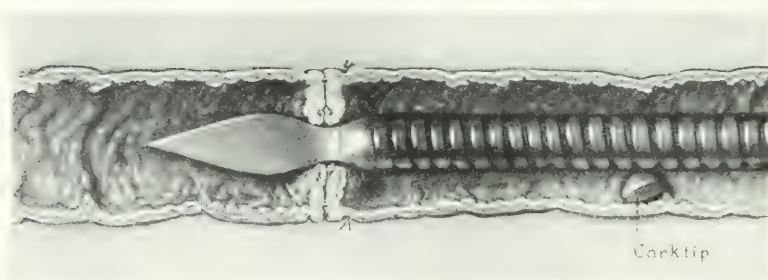


FIG. 13.—The cork pressed downwards and the purse-strings divided.

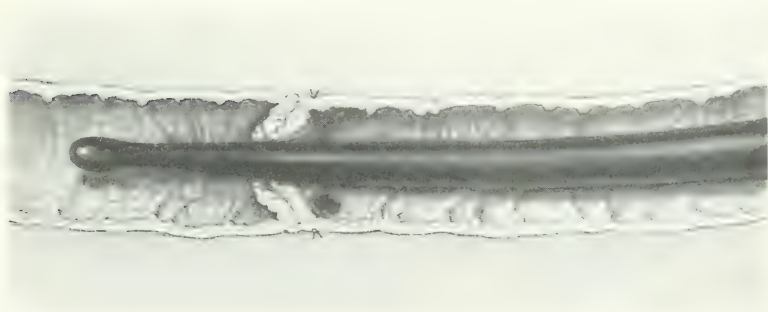


FIG. 14.—Bougie passed for control.

Sutures falling into the lumen of the bowel, being quickly transported, are lost; only such are discoverable as happen still to be attached to the intestinal wall when the animal is sacrificed. Those discarded on the peritoneal surface may remain for several years and be distinctly seen shimmering under an endothelial film. The more perfect the operation the fewer the adhesions, and frequently one finds every one of the loops outside if the mattress stitches have been happily made. Undoubtedly in the hands of novices most of the stitches penetrate the mucosa; nevertheless many of these perforating mattress stitches cut their way outwards; when they have pulled through the mucosa, the fistulous tract becomes sealed from within and the suture's passage towards the peritoneum may thereafter be a clean one.

The slogan "knots inside" naturally makes an appeal, for it seems universally to be taken for granted that the threads necessarily work their way into the lumen. Year after year for thirty-five years I have had opportunities to convince myself of the fact that in the cases which heal most ideally the stitches come to the peritoneal surface. The omental adhesions to the line of suture in such cases are very light (occasionally they are absent) and in a few weeks, in a few days even, may be absorbed and have left no trace.

Consulting the original paper of Lembert,⁹ I was interested to find that his stitches were cast off into the bowel. He states this definitely and makes no mention of having ever seen at autopsy a loop of thread shimmering under the peritoneum. This fact of itself suffices to prove that his stitches, contrary to the universal belief, were perforating ones. But we do not require this particular proof, for he distinctly states that he intentionally entered the lumen of the intestine with his needle, except when the wall was thick; and in this event the needle *glided*¹⁰ between the coats. Now it is questionable, I think, that even in the thick-walled cases he slid the needle between the coats without entering the intestinal lumen. He apparently knew nothing of the existence of the submucosa, and his needle, if it "glided," must have passed on one side or the other of this coat—either between the muscular and submucous coats, or between the latter and the mucosa; it could not *glide* along in the tough submucous coat. If the stitches had included only the peritoneal and muscular coats they would have split the longitudinal fibres, have constricted or crushed the circular ones and at best have had an insecure hold; and if they had perforated the submucosa they undoubtedly entered the intestine's lumen. Thus, in all probability, Lembert's stitches quite invariably entered the lumen, whatever the thickness of the bowel's wall; and, in any event, Lembert intentionally perforated the wall unless it was thick. Hence the Lembert stitch has been universally misunderstood, and the erroneous

⁹ A. Lembert: *Mémoire sur l'entéroraphie, avec la description d'un procédé nouveau pour pratiquer cette opération chirurgicale. Répertoire gén. d'anat. et de physiologie pathologiques, etc.* Paris, 1826, vol. ii, p. 100.

¹⁰ A. Lembert, *l. c.*, p. 105: "L'aiguille pénètre à 2 lignes environ du bord saignant droit, dans la cavité de l'intestin, ou bien sa pointe glisse entre les tuniques musculueuse et muqueuse, suivant que l'intestin est plus ou moins épais."

description of some early author has been passed on from one writer to another until the present time. Picture the amount of soiling there must have been in Lember's experiments. In placing his stitches he introduced a finger into the bowel, using it as a guide, as a darning ball.¹¹ Furthermore, the stitches perforated the intestinal wall and were discharged into the lumen. Nevertheless the five dogs upon whom he operated all recovered.

In the entire literature of intestinal suture there are, perhaps, no more impressive examples of nature's ability to protect against man's faulty operative methods than those furnished by Merrem's¹² resections of the pylorus (1809 and 1810).

Merrem excised the pylorus in three dogs—two in 1809 and one in 1810. In the first dog, attempts at invagination being unsuccessful, the raw edges of the stomach and duodenum were apposed and held by only three stitches. Death occurred on the twenty-third day from "inanition"; there was no peritonitis, and the suture-line was so well healed that no trace of it remained.

In the second and third dogs the stomach was invaginated into the duodenum—serosa apposed to mucosa. The second dog recovered; the third died. In all of the experiments the threads of the gastro-enterorrhaphy were brought out of the abdominal wound and fastened to the surface with adhesive plaster. The severed pyloric artery could not be tied on account of its depth; the hemorrhage was checked with sponge and spirits.

Let those of us who are inclined to be content with our present methods of end-to-end anastomosis bear in mind these experiments of Merrem and of many other early research workers and observe on animals the early stages of repair of our own intestinal sutures, to the end that we may understand the part that nature plays to protect the patient from the crudity of our handiwork.

Notwithstanding much experimentation, we have been unable to improve upon the method developed thirty-five years ago,¹³ unless perhaps the procedure submitted in this communication shall prove to be an advance. We have at least learned in recent years that it is safe, and probably advisable, to make a deeper inturn, and have devised a cleaner procedure. It remains to be determined whether in the blind-end method the continuous suture

¹¹ Lember, *l. c.*, p. 106: "Le chirurgien, . . . porte l'index de la main gauche dans la cavité de l'intestin, de manière à soutenir les bords saignans avec la pulpe de ce doigt."

¹² Merrem's paper (*Animadversiones quædam chirurgicæ experimentis in animalibus factis illustratæ*. Giessæ, 1810) is listed in the Index Catalogue of the Surgeon General's Library, but could not be located. Therefore I wrote to Professor Payr, who, unable to find it in Leipzig, kindly sent me Carl Langenbeck's abstract (*Abschrift eines Referates von C. J. M. Langenbeck, Professor der Anatomie und Chirurgie, Direktor des chirurgischen Spitals in Göttingen, aus Bibliothek für die Chirurgie*, 4. Band, 1. Stück. Göttingen. Rudolph Deuerlich, 1811). I appealed also to Prof. Felix Landois, of Berlin, who found Merrem's paper and sent me quotations from it which he had graciously translated into German.

¹³ W. S. Halsted: *Circular Suture of the Intestine—an Experimental Study*. *Amer. Jour. Med. Sci., Philadelphia*, 1887, n. s., vol. xciv, p. 436.

will yield results as good as those we have obtained by the mattress stitches. Better they can hardly be.

For lateral anastomosis the mattress stitches possess the advantage that they can all be taken before the bowel is opened, that one row of them suffices, and that infection of one stitch is unlikely to be conveyed to the others.

As stated earlier in the paper, it is not known how deep the inturn should be. It may safely be assumed, however, that the deeper the inturn the better, provided obstruction is not produced by it. Granting this, how many rows of suture should be made? Fortunately the apposed serous surfaces of the diaphragm tend to remain firmly in contact. That the process of unfolding begins promptly we know from the rapid cutting outwards of the properly placed sutures as well as from early observations on the mucous side; and from this continuous effort to unfold we infer the force maintaining the peritoneal surfaces in contact from the line of suture to the raw edges. Every stitch, whether essential or superfluous, interferes more or less with the circulation, hence the necessity for eliminating any that may be unnecessary. In circular suture of the intestines of a variety other than the blind-end we have advocated (1887, *loc. cit.*) a few presection stitches, taken chiefly with the purpose of preventing the outward rolling of the bowel wall and thus facilitating the introduction of the mattress row.

If we bear in mind that every perforating stitch is a source of danger, however slight, as well as a menace to the circulation, our efforts will be directed towards the suppression of unnecessary stitches and the cultivation of the sense which makes possible the appreciation with the needle's point of the resistance offered by the submucosa. That in resection of the human colon one row of mattress stitches is better than two, I am not as yet prepared to affirm, but in the dog it has given results in the blind-end suture so perfect that I should regard a second row as a factor of danger rather than security.

The more perfect the execution of any method of end-to-end anastomosis, the less reaction about the line of suture and the greater the rapidity of the unfolding of the inturn, of the complete restoration of the lumen of the bowel. In one of our specimens, for example, little remained of the diaphragm on the tenth day; in another there was no trace of it on the seventeenth day. On the other hand, the inturn in one case was about as deep on the 109th day as at the beginning. An exceptionally bad result in this case (an early one) was predicted because the force required to puncture the diaphragms with the three broad knives was so great that the stitches (perforating ones) tore little streaks in the bowel walls. The operation was cleverly performed by an eminent European surgeon who had not practised the submucous stitch. The animal's recovery and normal convalescence were surprising; at no time in the 109 days after operation were there symptoms of obstruction. It will readily be understood that great reaction, causing matting of the omentum and intestines about the line of suture, may lead to the formation of fibrous tissue in the infiltrated intestinal wall so dense and so extensive as to delay for a long time, and possibly permanently

prevent the complete unfolding of the intumescence. The surgeon should bear in mind this fact, unemphasized perhaps hitherto, and the experimenter in testing the relative merits of the various procedures for lateral as well as end-to-end anastomosis should note the rapidity of the unfolding and accept the tardy disappearance of the flange as evidence of a faulty technic either of method or execution or both.

The opportunity has not as yet presented at the Johns Hopkins Hospital to perform the blind-end suture on the human subject. We shall probably test it first on cases in which a lateral anastomosis is not feasible. The knife passes readily to the ileocaecal valve in the dog, and in one instance Doctor Holman, after resecting the caecum, abutted the closed ends of ileum and ascending colon and cut the diaphragms with the knife; the dog recovered normally. When the splenic flexure is hooked high (Payr's Doppelhülse) it might be difficult without mobilizing to traverse it with the knife. But for resections of the descending colon, of the sigmoid flexure, of the rectum when the sphincter is to be preserved, and possibly of the gastric end of the oesophagus, the method deserves, I believe, a trial.

I am greatly indebted to Dr. F. L. Reichert and to Dr. Emile Holman for assistance in every phase of the work. Dr. Mont Reid also has most kindly aided me in many ways. A detailed report of the experiments will be made later by Doctor Reichert and Doctor Holman.

THE POTENTIAL MALIGNANCY IN EXSTROPHY OF THE BLADDER

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ABERRANT epithelial tissue, undergoing malignant growth, is occasionally seen in unusual situations, especially in areas subjected to irritating influences. These unusual growths generally are the result of metaplasia, but occasionally they are the result of hyperplasia of tissue which is normally present in small amounts. The growths are usually composed of squamous cell tissue; they are occasionally associated with hyperplastic conditions of neighboring tissues, both may be the result of irritation. Bohm described a squamous cell tumor which had formed in the large intestine; the borders of the tumor gradually shaded off into normal glandular tissue. Nicholson collected nineteen cases in which squamous cell carcinoma had formed on the mucous membrane of the gall-bladder; in all but one the gall-bladder had been subjected to the irritation of stones. Deetz described a case in which the mucous lining of the gall-bladder was covered by a layer of squamous tissue. Zeller cited a case of squamous cell tumor of the body of the uterus in an area usually covered by glandular tissue. Broders noted the transition from squamous cell to basal cell and glandular formations in a case of carcinoma of the face.

The property of transformation of tissue is probably a characteristic inherent to the tissues themselves, the change being initiated by various forms of irritation or inflammation. Eichholz attempted to produce aberrant growths by the transplantation of tissue into unusual situations, but he was unsuccessful.

All exstrophied bladders show the results of irritation and trauma. Metaplasia and hyperplasia have gone on to such a degree that it is often difficult to find normal mucosa. The normal transitional epithelium has been replaced by an almost solid mass of glands. Vrolik, in 1822, first remarked on the curious mucous covering of exstrophied bladders. Lichtheim, in 1873, mentioned a complete glandular covering on an exstrophied bladder observed by him. Enderlen also observed this condition in several cases. He stated that it is impossible to determine at what age the condition develops; he found it in an infant of eighteen months. He studied the development of the urinary bladder in a series of embryos, and noticed that occasionally there was delayed formation of the urogenital sinus. This sinus or opening penetrates the cloacal membrane, which divides the primitive cloaca into the bladder and rectum, establishing the patency of the outlet of the bladder. Owing to this imperfect coördination of growth the bladder and its outlet

are not united at a period early enough to drain the urine from the embryonic bladder; consequently this viscus ruptures through the cartilaginous pubic bones and becomes an external organ. Another theory is that exstrophy is merely a continuation upward toward the navel of a normal splitting process that forms the anal opening.

Ehrich explains the presence of the glandular covering over exstrophied bladders from an embryologic standpoint. The bladder and intestines both come from the same source; due to its unusual situation the bladder has not the stimulation to change over to the usual type of transitional epithelium but retains that of the intestines. The work of Haché supports this theory; he collected six cases of exstrophy of the bladder in which the intestine and bladder were united, the intestinal opening persisting on the surface of the misplaced bladder. Enderlen's studies seem to disprove Ehrich's theory. In a number of exstrophied bladders from infants who died at birth he found a normal transitional epithelium. Evidently the glandular formation is not a result of embryonic changes but occurs in response to some stimuli developing after birth.

In exstrophied bladders from adults extensive glandular formations may be found in almost any area. The normal transitional epithelium has practically disappeared and various gradations of metaplastic changes may be traced from the normal epithelium to solid glandular masses and extensive squamous-cell coverings. This process probably results from a combination of metaplasia with hyperplasia of the normal glands often seen in the mucosa of the bladder. Such glands, which generally consist of a few cells only, are well described by von Brunn and von Limbeck. Later Stoerck and Zuckerkandl described a glandular cystitis which developed into malignancy as a result of constant irritation. In exstrophy of the bladder the exposure to the air, the constant irritation of the clothing, the frequent trauma and persistent infection, with the possible need for a protective mucous covering or mucous secretion, furnish an excellent stimulation to cellular hyperplasia. The almost constant association of squamous-cell covering, a type of growth which is rarely formed unless a protective surface is necessary, gives evidence of the extent of the irritation and trauma.

Ewing states that the study of many adenocarcinomas indicates that the pure adenomatous structure may represent an intermediary or transitory stage in the evolution of the tumor, which is rapidly traversed and soon passes into a more typical carcinomatous phase. This progress is often seen in tumors of the breast; the dividing line between benign and malignant neoplasms is often questionable, and intermediate and border-line growths are often seen. In malignant prostates the various transitional stages from a benign glandular area may occasionally be traced to a definite area of malignancy.

Nine exstrophied bladders, removed from patients at the Mayo Clinic,

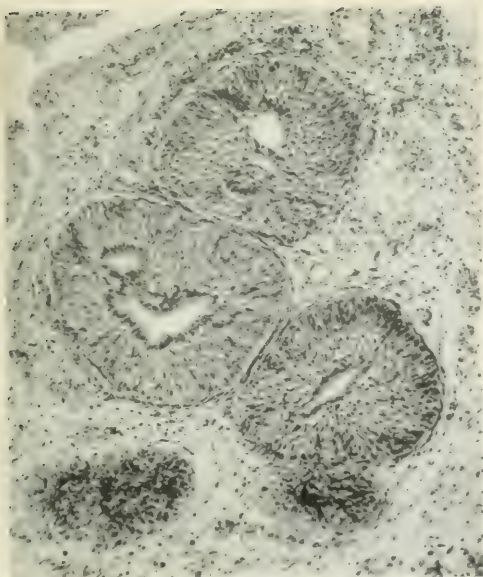


FIG. 1.—(Case 105862). High cylindrical cells lining the surface of inverted bladder mucosa (X 100).



FIG. 2.—(Case 105862). Section of exstrophied bladder from an infant, showing early stage of transition from the normal mucosa to glandular type (X 100).



FIG. 3.—(Case 200894). Section from bladder showing large alveoli (X 50).



FIG. 4.—(Case 103182). Squamous cell surface from exstrophied bladder (X 50).



FIG. 5.—(Case 193182). Glandular area showing extensive mucoid degeneration of cells. Small dark nuclei located at base of cells (X 100).



FIG. 6. (Case 219383). Group of glands showing compact and irregular formation (X 50).



FIG. 7.—(Case 251343). Squamous covering of bladder overlying glandular area (X 50).

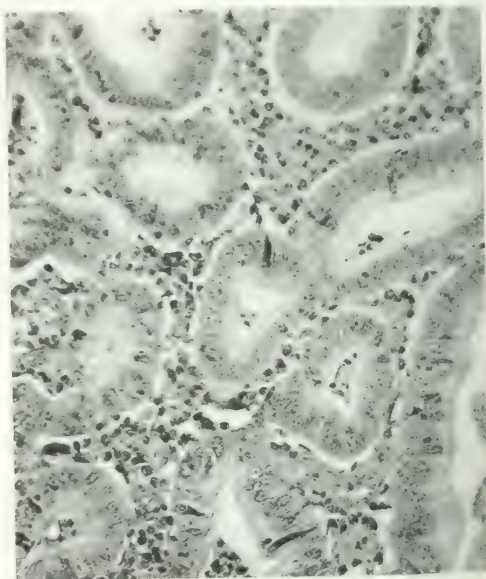


FIG. 8.—(Case 190148). Adenocarcinoma on exstrophied bladder (X 200).

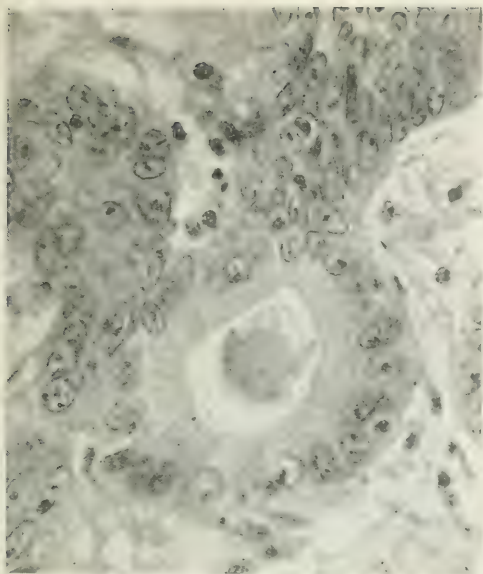


FIG. 9.—(Case 190148). Malignant cells with large irregular nuclei and prominent nucleoli (X 500).

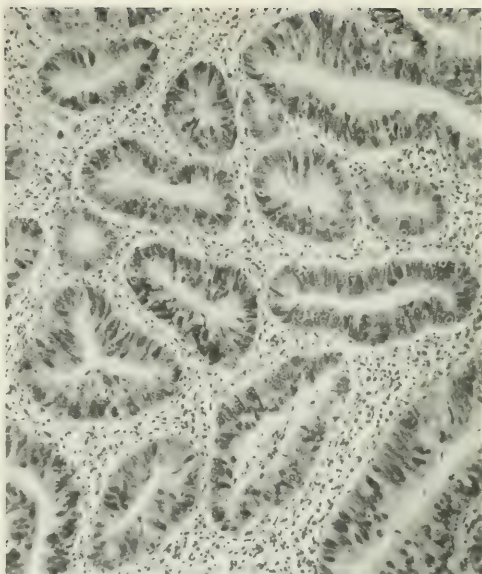


FIG. 10.—(Case 375285). Glandular malignancy from an exstrophied bladder in a man aged forty-four years (X 100).

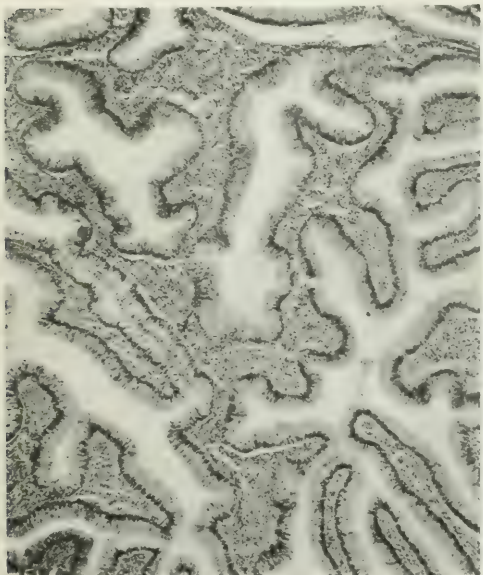


FIG. 11.—(Case 375285). Papillary arrangement of glandular cells (X 500).



FIG. 12.—(Case 375285). Adenocarcinoma covering the left half of the exstrophied bladder. The ureteral orifices at the base of the bladder are not involved in the malignant area.

were examined grossly and histologically in an effort to establish the connection between the constantly present hyperplastic mucosa and the glandular malignancy which so often develops. Brief histories of these cases are given.

CASE I (105862).—H. L., a girl aged four years, was brought to the Clinic because of exstrophied bladder, May 12, 1914. The surface of the bladder was roughened and thickened; it contained many thin-walled cystic dilatations, a number of which were filled with a bluish colloid material. Microscopically a few small groups of glands with uniform and regular acini were seen. The cells composing these glands were of the high cylindric type; they were regularly disposed and were uniform in size and shape. In several areas the infolded surface layer of epithelium was seen to be undergoing glandular changes, such as large cylindric cells arising directly from the mucosa of the bladder (Figs. 1 and 2). In a few areas normal transitional epithelium was found, but in most instances the bladder and glandular areas were covered by thickened and hornified epithelium.

CASE II (200894).—H. McG., a boy aged six years, was brought to the Clinic July 12, 1919, on account of an exstrophied bladder. The surface of the bladder was roughened and contained many small dilated cysts. Clear urine was seen spurting from both exposed ureteral openings. At operation the bladder was removed completely and the ureters transplanted. Microscopic examination of the wall of the bladder revealed extensive areas of glands with irregular acini, some small and circular, others dilated and tortuous. Only a small amount of intervening stroma separated some of the glands. The cells lining a number of the alveoli were hypertrophic, irregular, and often contained very large deeply-staining nuclei. In a few areas the glands were lined by several layers of cells, and occasionally masses of cells were seen with glandular lumen practically obliterated (Fig. 3).

CASE III (226575).—T. B., a boy aged fifteen years, was examined in the Clinic March 28, 1918. He had a completely exstrophied bladder, the covering of which was red and inflamed from constant moisture. The bladder was removed and microscopic examination of the mucosa revealed many large unilocular cysts lined by two or three layers of flat epithelial cells. There were many long perfectly formed glands. The cells forming the alveoli were uniform in shape and arrangement; the nuclei were small, deeply stained, and situated at the bases of the cells.

CASE IV (193182).—Mr. A. Z., aged eighteen years, came to the Clinic May 14, 1917, because of an exstrophied bladder. The surface of the bladder was fairly smooth and regular. The openings of both ureters were visible, and spurting clear urine. Microscopic examination of the bladder after its surgical removal revealed a well-developed squamous-cell surface covering the entire bladder (Figs. 4 and 5). Below this many well-formed small glands were found. In a number of areas the glandular lumen opened directly on the surface of the bladder.

CASE V (219383).—Mr. J. M., aged twenty-one years, came to the Clinic January, 1918. He had an exstrophied bladder, the surface of

which was deeply furrowed and contained many cystic areas. The bladder was removed and microscopic examination revealed many regular and well-formed glands. In some areas many small alveoli were bunched together. There was moderate round-cell infiltration of the submucous tissues (Fig. 6).

CASE VI (211574).—Miss P. C., a woman aged twenty-two years, came to the Clinic October 23, 1917, for treatment of complete exstrophy of the bladder. The surface of the bladder was fairly smooth and contained a number of small, projecting, glandular nodules. The ureters were transplanted to the rectum and the bladder removed. Microscopic examination revealed many large and small alveoli lined with high columnar epithelial cells and filled, often, with detritus. The individual cells were large and occasionally swollen and contained a faintly staining homogeneous material.

CASE VII (251343).—Mr. C. S., aged twenty-five years, came to the Clinic for examination September 13, 1920. He had a small exstrophied bladder, which was removed. Microscopic examination of the mucosa revealed very extensive glandular formation; in some areas great masses of alveoli were matted together with practically no intervening stroma (Fig. 7). The individual cells showed hypertrophy and often contained large, deeply staining, centrally located nuclei. The glands were irregular and tortuous, and often large ducts opened on the surface of the bladder.

CASE VIII (190148).—Miss L. W., aged twenty-three years, came to the Clinic April, 1917. She had a completely exstrophied bladder, which had recently increased in size. The upper half of the bladder was 3 cm. in diameter, firm, and irregular. The histologic examination after removal revealed well-marked adenocarcinoma. The growth contained many large and small alveoli, with great masses and strands of glands linked together. The cell layers were duplicated and in some areas the alveoli were represented only as a great mass of hypertrophied cells. The individual cells were irregular in size and shape and in general did not conform to the contour of the alveoli. The nuclei were extremely large, generally centrally situated and in most cases stained deeply (Figs. 8 and 9). In spite of the thorough removal of the growth, the patient died two years later from metastasis.

CASE IX (375285).—Mr. L. M., aged forty-eight years, came to the Clinic October 20, 1921, for examination of a tumor on an exstrophied bladder. The growth had appeared on the left side of the exposed mucosa about one year before. During the last few months it had increased rapidly in size and had bled freely. On examination a large scar was found directly above the bladder, the result of an attempted repair of the exstrophy thirty years before. A rounded irregular tumor 4 cm. in diameter, which almost covered the bladder, projected above the mucosa about 2 cm. On raising the lower border of this growth both ureteral orifices were seen; clear urine spurted from each. Under local anæsthesia the mucosa of the bladder and the tumor were excised. Both ureters were found to be thickened and

dilated; they were not disturbed. The mass removed was moderately solid; it was covered with short stubby protrusions. Histologic examination revealed a typical adenocarcinoma which had spread into the surrounding mucous membrane (Figs. 10 and 11). In some areas the tumor was composed of heavy papillomatous projections resembling a papillary adenocarcinoma of the ovary or thyroid. There was marked round-cell infiltration consisting mainly of plasma cells. Sections taken through the prostate, closely associated with the misplaced bladder and removed with it, did not reveal malignancy (Fig. 12).

Discussion.—The mucosa of exstrophied bladders, particularly in adult patients, contains areas gradually approximating or shading off from fairly normal to definitely malignant tissue. In the youngest patient of the series (Case I) a moderate amount of normal epithelium was still present and the gland formation was only slightly advanced. In most instances the extent of such formation seems to vary with the age of the patient. The patient in Case II is an exception to this rule. In the specimen very extensive gland formation was seen. There was irregularity in size and shape, reduplication of the lining cells, large deeply staining nuclei, together with a disorderly rambling of the groups of glandular cells into the surrounding tissue. The histology in Cases VIII and IX, the two cases in which there was definite malignancy, was similar to that described by Ewing as adenoma destruens, a type of tumor which generally occurs in the large intestine, a portion of the bowel which embryologically is associated with the bladder. The glands were very extensive and were grouped together, forming large irregular masses. Stoerck and Zuckerkandl reported a similar case of adenocarcinoma on an exstrophied bladder occurring in a woman of fifty. They believed that the malignancy developed following hyperplasia of the mucous glands. Hager reported a case of adenocarcinoma developing on an exstrophied bladder in a man aged sixty-six years; the tumor covered the upper half of the bladder. Lower removed an adenocarcinoma from a man of fifty. The exstrophied bladder in this case was irritated by a metal appliance worn by the patient. Ehrich reported a case in a woman aged forty-four years, who died one month after the removal of the growth. In the region of the tumor, areas of thickened glandular tissue were found. Geraghty reported a case, seen at the Johns Hopkins Hospital, of an adenocarcinoma occurring in an exstrophied bladder. Similar cases are also noted by Enderlen and Bergenhem.

The striking feature about these tumors is that they are all adenocarcinomas, a type which would develop directly from hyperplastic adenomatous tissue. No other type of malignancy has been noted in exstrophy of the bladder. This is in marked contrast to the types of tumors occurring in normally situated bladders; adenocarcinoma makes up only about 2 per cent. of such growths. There were five adenocarcinomas in 333 tumors of the bladder treated at the Mayo Clinic.

It is difficult to estimate the relative frequency of malignancy in exstrophied bladders as compared with those normally situated. Marion states that the condition occurs about once in 50,000 births, and that nine-tenths of the patients die in infancy or a little later. In 367,000 patients at the Mayo Clinic there were sixty-nine with exstrophy of the bladder (one in 5318); in three of these the condition was malignant. The cases of two are described in this series; in the third the growth was inoperable.

The incidence of malignancy in exstrophy of the bladder is relatively high in reported cases as compared to the incidence of exstrophied bladders or to the incidence of malignancy in normal bladders. This relative frequency of malignancy, with the repeated occurrence of conditions approximating malignancy, suggests that exstrophied bladders should be removed as early as possible in all operable cases.

SUMMARY

Exstrophied bladders that are subject to constant irritation and trauma have an extensive glandular covering, the result either of metaplasia from the normal covering or of hyperplasia of glands in the mucosa. Such glandular structure often shows characteristics approximating malignancy. In nine cases of exstrophied bladder, in which material for histologic study was available, two were definitely malignant, and two showed atypical cellular formation varying markedly from the normal.

In the reported cases of malignancy of exstrophied bladders, which are relatively frequent, the growths were adenocarcinomas. This glandular malignancy is the type that would develop from irritation and hyperplasia of glandular structures.

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INTERMITTENT HYDRONEPHROSIS WITH GASTROENTEROLOGIC SYMPTOMS*

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FOR a long time hydronephrosis has been known as the great mimic in abdominal pathology. The mass in an upper quadrant of the abdomen has been mistaken for a distended gall-bladder, a cyst of the pancreas and various other tumors.

The changes of urinary function in hydronephrosis are seldom great. Ordinarily the disease is unilateral and therefore systemic indications of urinary disturbance are rarely present. The tumor may never be large and during the periods of remission or intermission may become so small as to escape notice.

Disturbance of gastro-intestinal function may be the only constant feature of the condition. Dietl's crisis, characteristic of movable kidney and believed to have its origin in a vascular or ureteral obstruction, points out a reflex relationship between the urinary and alimentary organs.

Gastro-enterological symptoms therefore may become of the greatest importance in the course of an intermittent hydronephrosis. The possibility of the condition must be borne in mind whenever a confusing set of symptoms can not be explained by the presence of a clearly identified lesion of the alimentary tract or its associated organs. Under such circumstances a complete urological examination, including catheterization of the ureters, measurement of the capacity of the pelvis, determination of the function of both kidneys, and pyelograms will prove the presence or absence of a hydronephrosis.

Early in the course of the disease conservative operations, varying from dilatation of a strictured ureter to plastic anastomosis between this tube and the pelvis of the kidney, are to be performed. Late in the disease, when the accompanying progressive sclerosis of the pelvic walls and the kidney parenchyma has seriously impaired the function of the organ, nephrectomy is indicated. Before resorting to this radical operation, however, the possibility of improving the function of the kidney, after the pressure has been relieved, should be considered. This point may become of great importance when the condition of the other kidney is also below normal.

Hydronephrosis is not a rare lesion, and the two cases now reported are brought to your attention only because the gastro-enterological symptoms are so prominent in their clinical course.

CASE I.—S., 1836. The patient, a white boy, age thirteen, was admitted to St. Agnes' Hospital, June 11, 1908, on account of recurring

* Read before the American Gastro-enterological Association, June, 1921.

pain in the abdomen, with nausea and vomiting and constipation. The symptoms had been present ten years. The boy had been studied by several eminent clinicians, but no diagnosis had been made.

The attacks came on without any relation to the taking of food, at intervals of about two weeks, and lasted from twenty-four to forty-eight hours. During the attack there was bulging of the left side of the abdomen, with a ball-shaped swelling at the outer border of the left rectus between the umbilicus and the anterior superior spine. The pain was colicky and referred to the region of the ball-shaped swelling just described, and to the costal margin in the left mammary line. The pain did not radiate in any direction. Recovery from the attack was prompt. Usually the next day the boy was able to go to school. During the interval he was entirely well.

Examination of the abdomen revealed a small bulging at the outer border of the left rectus muscle at the level of the umbilicus. Pressure at this point brought out gurgling and a sense of splashing. No other masses or areas of resistance could be felt. A peristaltic wave was seen passing downward with respiration from the tip of the xiphoid across the abdomen.

Dilatation of the bowel with air through a rectal tube showed even distention, except in the region of the cæcum. As the bowel became distended, the patient complained of pain in the left flank, similar to the pain during an attack. Bismuth X-ray showed a break in the shadow in the descending colon just above the sigmoid. This was attributed to air or fæces in the bowel. At the time of this examination (1908) our limited experience did not permit us to make any deductions from the X-ray plate. Sigmoid volvulus, and congenital dilatation of the colon were considered as possible causes for the symptoms. The blood count was normal and there were no pathological changes in the several specimens of urine examined.

While in the hospital the boy had an attack. Considerable bulging of the left flank was noted. The colicky pain was severe. The ball-like mass at the edge of the rectus was tender. There was frequent desire to urinate and a considerable quantity was passed with each voiding. As the attack subsided the bulging of the flank disappeared. After this attack the possibility of an intermittent hydronephrosis was considered as a cause of the boy's illness.

On July 3rd Doctor Bloodgood opened the left flank behind the peritoneum at the level of the umbilicus, by a muscle-splitting incision. The moderately distended sac of the hydronephrosis was identified and brought up to the surface. The wound was partially sutured and then iodoform gauze was packed around the sac to wall off the other tissues. The sac was opened by a minute incision. Urine began to flow at once.

The wound gradually healed, and closed down to a pinhead-sized urinary fistula situated in the flank. This fistula drained for nearly two years. At the end of that time, it was closed by separating the sac from the abdominal wall and plicating it until the several layers made a band of tissue about one-half inch wide firmly fixed against the side of

the kidney. This manoeuvre was successful. The wound healed without complications and there was no more leaking of urine. The patient is now a vigorous and active young man, cured eleven years.

CASE II.—S., 20695. The patient, a white female, age seventeen, was admitted to the Mercy Hospital January 13, 1921, on account of constant pain in the abdomen, with nausea and vomiting. There were paroxysmal exacerbations of the pain. She had suffered from attacks of acute indigestion for some time, but a routine physical examination made in May, 1920, did not reveal any masses or tender areas in the abdomen.

The present attack had begun about two weeks before admission with acute indigestion followed by diarrhoea and pain in the upper left quadrant. At the time of admission there was a disk-like mass about the size of a silver dollar, just under the outer edge of the left rectus muscle, about two inches above the umbilicus. This area was tender and was flat on light percussion. This disk-like mass was considered part of a larger smooth, firm, swelling which extended upward to the costal margin and outward to the anterior axillary line.

The large swelling was regular in outline and moved with respiration and from side to side. The tender area was taken to be a mass of omentum, plastered over a slowly leaking gastric ulcer, and binding it to the abdominal wall. The stomach contents were free from blood and contained less than the normal quantity of acid. X-ray study showed a dilated stomach with a remarkable zone into which the bismuth did not penetrate (Fig. 1). The colon picture was negative. The gastric shadow was interpreted as one due to extra-gastric tumor behind the stomach, or a polypoid growth within the organ. A few days later the pain became much less severe and we noted that the mass in the flank had become smaller. Later the mass recurred and with it the pain. We then felt reasonably certain that we were dealing with a hydronephrosis.

The urological study made by Dr. A. J. Gillis showed a phthalein output of less than five on the left and of forty-five on the right side. There was some difficulty in passing the catheter through the left ureter. The sodium iodide pyelogram showed clearly the dilated ureter and the swollen pelvis of the kidney (Fig. 2). Because of the low phthalein output of the left kidney and the good output of the right one, we decided to remove the functionless kidney rather than risk a urinary fistula in the attempt to do a plastic operation.

Operation, January 24, 1921. McGlannan. Anæsthetic, nitrous oxide. The mass was exposed by a lumbar incision. The sac was aspirated and 550 c.c. of fluid recovered. The kidney and the sac and about two inches of dilated ureter were removed. The wound was closed with drainage and healed without any complications. The patient is now well.

Analysis of the fluid from the sac showed it to contain a small quantity of urea. It was free from albumin or sugar. Examination of the sediment after centrifugation revealed a number of poorly stain-



FIG. 1.—Case II. Radiograph of stomach showing the area which was not reached by the barium-meal.



FIG. 2.—Case II. Pyelogram showing the dilated ureter, swollen kidney pelvis and cystic cavities.



FIG. 3.—Case II. The excised kidney and hydronephrotic sac.



FIG. 4.—Pyelogram from Doctor Samuels' case.

ing cells with single nuclei, some bacilli which resembled the colon bacillus. There were no white blood-corpuscles present.

Gross pathology: The specimen consists of the kidney, the hydronephrotic sac and about one inch of ureter. The ureter is dilated, its walls are thin and the lumen is about 1 cm. in diameter. The sac is thin walled and has a capacity of about 500 c.c. The cut surface of the kidney shows a small area of parenchyma at either pole and around the convex border. The greater portion of the kidney is made up of cystic areas which are the dilated calyces. Between these cystic dilations the tissue is gray and fibrous. The photograph (Fig. 3) shows the kidney cut open with the hydronephrotic sac attached at the hilum. A thin layer of kidney tissue is shown at the outer edge of the sac.

Through the courtesy of Dr. A. Samuels, I am able to add the report of another case of gastro-intestinal disturbance due to hydronephrosis.

The patient was a white woman, thirty-five years of age, who had suffered for three years from attacks of abdominal pain with vomiting. The symptoms were not associated with the intake of food. An operation, whose nature could not be learned, had been performed through an epigastric incision soon after the onset of her symptoms, but it had not given her relief. The attacks varied in their frequency and in severity. She had passed through two pregnancies since the onset of her symptoms and thought the recent exacerbations might be due to another pregnancy. The physical examination proved that the patient was not pregnant and discovered a tender, smooth mass in the region of the left kidney.

Urological examination showed that the left kidney held 1500 c.c. of fluid, while the right one had a 20 c.c. capacity. The phenolsulphonphthalin test proved the left kidney functionless. The pyelogram showed the hydronephrotic sac (Fig. 4).

The patient was cured by nephrectomy.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held December 14, 1921

The President, DR. JOHN A. HARTWELL, in the Chair

BRAIN TUMOR WITH FEW LOCALIZING SYMPTOMS

DR. CHARLES A. ELSBERG presented a woman, twenty-four years of age, from whom he had removed a large tumor from the right parieto-frontal region about one year ago. She complained of continuous severe headache and interference with vision. Physical examination showed nothing with the exception of a high grade of papillœdema with hemorrhages in both eyes. Neurological examination was entirely negative. Vision finally began to deteriorate rapidly and it was determined to do a decompression. A few days before the operation the patient complained of a peculiar sensation in the right cheek, and upon examination there was found a slight diminution in sensation of the right cornea. Based upon this, Doctor Elsberg determined to expose the right frontal and parietal lobe and to investigate whether there was a neoplasm which caused pressure upon the first and second branches of the right trigeminus. At the operation a large endothelioma, measuring 5x7x4 centimetres was removed from the right fronto-parietal region. The patient's headaches disappeared at once and she has been entirely well since that time, excepting that she presents some signs of frontal lobe disturbance.

CYST OF THE CEREBELLUM

DOCTOR ELSBERG made some remarks upon the sensitiveness of the medulla if the least pressure is made upon it acutely, and then presented the following case to show what the medulla will withstand if the pressure is a very gradually increasing one. The patient was a boy, twelve years of age, who presented symptoms of a left cerebellar lesion of six months' duration. He was markedly ataxic in all extremities. In November, 1918, Doctor Elsberg did a suboccipital craniotomy and emptied a cyst in the left cerebellar lobe, cauterizing the inner surface of the cyst with pure carbolic acid. The patient remained perfectly well for two years and then all of the symptoms recurred with again a marked papillœdema and marked ataxia. A second operation was done in June, 1921. At this operation a large cyst was again found, but this time the cyst involved not only the left cerebellar lobe, but extended across the median line into the right cerebellar lobe. The cyst contained a large amount of yellow fluid. The fluid was evacuated, one or two small gliomatous knobs excised and the whole cavity swabbed out with Zenker's solution. The patient recovered from the operation very satis-

SPINAL SYMPTOMS COMPLETELY RELIEVED BY LAMINECTOMY

factorily, the papillœdema subsiding very rapidly and all of his symptoms disappeared. He is now free from symptoms, except for a slight dysmetria in the left upper extremity.

RECURRENT SPINAL CORD TUMOR

DOCTOR ELSBERG presented a young man, twenty-eight years of age, who, in 1919, had been admitted to Mount Sinai Hospital with the signs of an extramedullary compression of the spinal cord at the sixth cervical level on the left side. At the operation on May 14, 1919, a spinal cord tumor lying on the left side and in front of the cord was removed. The pathological report was fibroma. The patient recovered very satisfactorily from the operation and remained perfectly well for two years. He then returned to the hospital with the story that for six weeks his symptoms had begun to return, and they were at the time of his admission as severe as they had been before the previous operation. The signs and symptoms again pointed to the sixth cervical segment of the cord. A second laminectomy was done by Doctor Elsberg on June 7, 1921, and another tumor of about the same size as the previous tumor was removed from the same location of the cord. The tumor was well encapsulated and easily removed, as had been the first tumor. The pathological report on the second tumor was spindle-cell sarcoma, and when the pathologist reexamined the first tumor which had been removed, he found a small area undoubtedly sarcomatous, and therefore changed the diagnosis on the first tumor to that of spindle-cell sarcoma. The patient recovered very satisfactorily from the second operation and was presented practically well.

Doctor Elsberg remarked that this was the first case of true recurrent intradural tumor that he had ever encountered.

SPINAL SYMPTOMS COMPLETELY RELIEVED BY LAMINECTOMY

DOCTOR ELSBERG presented a girl, twenty-five years of age, upon whom he had operated in February, 1921. The patient had a thirteen months' history of pain in the lower right chest, coming in attacks, and diagnosticated as "dry pleurisy." She had had some trouble in the lower extremities when she was admitted to the Neurological Institute. Upon examination she presented signs of compression of the cord at the seventh thoracic segment. A laminectomy was performed on February 21, 1921. Excepting for a slight thickening of the arachnoid and an apparent localized collection of fluid under the arachnoid, nothing pathological was found. The wound was closed and the patient made an uncomplicated convalescence. All her motor and sensory signs disappeared and she has been free from pain and feeling perfectly well since that time.

Doctor Elsberg remarked that this was one of the effects that one sometimes sees from an exploratory laminectomy. While the thickening of the arachnoid may have had something to do with her symptoms, there was not sufficient pathologically found to explain her symptoms or to explain the complete relief after the laminectomy.

SPINAL CORD TUMOR; LAMINECTOMY; COMPLETE RECOVERY

DOCTOR ELSBERG presented a woman, forty-eight years of age, who had had a complete spastic paraplegia with paralysis of the bladder and rectum when he operated upon her in June, 1921. At the operation a tumor, 3 x 2 centimetres in size, adherent to the dura, was removed from the level of the sixth and seventh thoracic segments. The patient rapidly regained what she had lost. She had complete control over her bladder one week after the operation, and within six weeks of the operation had regained entire control over the extremities. She was presented without an evidence of either motor or sensory disturbances, and feels perfectly well.

RECONSTRUCTION OF COMMON BILE DUCT

DR. FRANK S. MATHEWS showed a patient first seen at the age of twenty-two. Eight months previously her gall-bladder, which contained no stones, had been removed for unknown reasons. Following the operation, all bile drained externally. As the sinus narrowed, chills and fever developed and she was reoperated upon, nothing being done but an opening of the wound to promote drainage.

When seen by Doctor Mathews all the bile was draining externally. Sinus would close for a few hours, followed by a chill and fever. At his first operation a sinus was found leading to the transverse fissure and directly into the liver. No stump of duct remained connected with the liver. The hepatic duct lay an inch and a quarter from the fissure. The end was opened and efforts made to suture it in contact with the under surface of the liver. The operation had been very long, blood loss considerable and patient was much shocked and required transfusion. The wound was infected and a total failure as far as restoration of the duct was concerned. However, the condition to be dealt with had been learned, the chills terminated and patient's general health restored.

Six months later, in August, 1920, with patient in good condition, an operation for reconstruction was undertaken which has proven a complete success. At the time of operation patient was three months pregnant. The duodenum was separated from the hepatic and common ducts, exposing them for a considerable distance. The closed end of the duct was opened and a rubber tube inserted in the open end of the duct. Some distance below and just where crossed by the duodenum, a small incision was made in the side of the duct just large enough to admit the tube. The other end of the tube was inserted three inches into the liver and the end of the duct held in contact with the liver by means of two or three chromic sutures. It seemed simpler and easier to bring the tube out of the small lateral opening in the duct than to attempt to pass it down through the common duct into the duodenum. All the bile drained through the tube and none around it. The tube was removed on the seventeenth day. There was no drainage of bile from the sinus and the color returned to the stools at once. No apparent impairment of health could be traced to the total absence of bile in the intestine

for a period of two years. The pregnancy was not interrupted by the operation.

DR. JOHN DOUGLAS presented a woman fifty-six years of age, who was operated on at St. Luke's Hospital in October, 1919, for acute cholecystitis. The gall-bladder was acutely inflamed and contained a number of stones. The wall was necrotic and there was considerable bile-stained fluid in the portion of the peritoneal cavity surrounding the gall-bladder. The common duct contained sand-like material and detritus but no stones. The gall-bladder was removed, and in its removal the cystic duct pulled off from the common duct, injuring the wall of the common duct but not dividing it. The débris from the common duct was removed through this opening after enlarging it. The opening of the common duct was partly closed by suture and a rubber tube inserted upward for drainage. There was a high temperature and infection of the wound following the operation, and a biliary drainage existed for from six to seven weeks. The patient then left the hospital with a sinus still present with no bile drainage. She returned to the hospital in January, 1920, with an area of cellulitis about and above the operative incision. At this time it was found that there was a necrosis of several of the costal cartilages above the operative incision. She remained in the hospital until April, 1920, and went home healed. In August, 1920, she became jaundiced. This jaundice never entirely disappeared, but she had attacks of pain in the right hypochondrium, accompanied by chills and fever, at which time the jaundice would become more severe and then later become less. She is sure that since this time her faeces were always clay colored.

In October, 1921, two years after her first operation, she again entered the hospital, with marked jaundice; the skin and conjunctiva were of a dark greenish-yellow color, the stools were clay colored, the urine contained a large quantity of bile and no bile could be obtained by the duodenal tube. She had no temperature elevation. Coagulation time was three minutes. At the second operation the common duct was found without great difficulty as there were a surprisingly small number of adhesions. It was identified at the distal end by aspiration of mucus by hypodermic needle. Above this closed end was a strand of connective tissue which led up to a point just below the junction of the two hepatic ducts which was closed off tight and distended with bile. This was also identified by aspiration with a hypodermic needle. The two ends were opened, mobilized and sutured together with chromic gut about a T tube. This tube was sutured into the wound to prevent pulling out. After the operation part of the bile drained through the tube, and a considerable quantity immediately entered the intestines as the movements were bile stained. On the twelfth day she accidentally pulled out the tube. There was some discharge of bile from the wound for twenty-four hours, none thereafter. The wound healed rapidly and since the time of operation the patient has had no return of her pain or temperature. Her jaundice has disappeared and her movements are normal in color.

The particularly interesting facts about this case are: First, that

the stricture of the duct must have been due principally to pressure of the drainage tube, plus infection, as the duct certainly was not divided at the time of operation. Second, the fact that the external sinus closed, although the common duct was completely obstructed, as a rule these cases having a permanent or intermittent fistula. Third, the long period during which a complete or almost complete closure of the common duct must have been present. Fourth, the short coagulation time of the blood and the presence of a marked jaundice.

Doctor Douglas asked the members of the society how long they thought the arms of the T tube should be, as, of course, the longer the arms the easier the tube would stay in place, and also the more difficult it would be to remove the tube, and the more chance of injury to the anterior wall of the duct in removing the tube. He also inquired how long the members of the society, who had any experience with the use of the T tube in such cases, believed that the tube should be left in place before removal. It had been his intention to leave the tube in from three to four weeks, but the patient accidentally pulled it out at the end of twelve days.

DR. JOHN F. ERDMANN said that he had had six of these patients, four of whom recovered while the other two cases resulted fatally. In each instance he used a small-sized catheter, introducing it high into the hepatic duct or the remains of the common duct, the terminating end of the catheter with its extra length being introduced into the duodenum either through the common duct, if it could be found, or a new opening being made in the duodenum, the catheters being fixed in the ducts with one or two stitches of chromicized catgut. In the first patient upon whom he used this method the catheter was passed in about the eleventh week. When she came to him there had been continuous loss of bile and her weight had gone down from 125 to 87 pounds. At the time of operation there was great difficulty in finding the proximal orifice and the distal orifice could not be found. At the end of about eighteen months this patient had to be reoperated upon for stenosis. At the time of the second operation the duodenum was attached to the opening of the hepatic duct. This patient is now living and is in excellent health.

The second patient had been operated upon at another hospital in the city. When Doctor Erdmann saw her she was suffering from jaundice and spasms and there was a slight amount of leakage from the abdominal wall. At operation an obstruction to the common duct was found. The same type of procedure was followed as in the first patient. The catheter was found in the cæcum at the end of the seventh or eighth week. At the end of the seventh month it was still visible in the large intestine. Since that time X-rays have not shown any retained tube.

The fourth patient died of pneumonia; the fifth, his own, died of shock. In this patient he cut off a portion of the hepatic duct as a result of the spinal attachment of the cysticus to the common duct.

The sixth patient was a man upon whom he operated two years ago. He found the proximal end very easily as a bulbous mass on the

under surface of the liver—in other words, the opening of the hepatic duct. The man got along exceptionally well, but has since been operated upon twice, and is now ready to undergo a third operation at still another man's hands.

He never had used the T tube, feeling that the extraction of this tube would tend to traumatize the newly repaired tissues. In four of these patients he operated through the old perpendicular incision; in the other two he made a T incision by splitting the right side down to the mid-axillary line.

DR. ALLEN O. WHIPPLE said that the point brought up regarding the pressure of the drainage tube as a factor in stenosis he thought to be extremely important. In certain cases this factor would seem to be the only explanation for subsequent stricture. In two cases of stricture that he knew of, where the operators in their account of the operation made very clear the fact that the common duct was in no way injured, subsequent stenosis was explained only by pressure of the drainage tube. It is worth remembering that the drain should be kept well to the right and away from the gastro-hepatic omentum. This is very true in cases associated with infection.

DR. SEWARD ERDMAN related an experience with one case in which the common duct had been completely divided. On the tenth day he did a reconstruction operation and found it possible to approximate the cut ends of the duct over a T tube which he left in for twenty-eight days. The cut ends were found separated by a distance of 2 cm. It seemed advisable to leave the tube in for a long time, so he did not remove it for twenty-eight days, after which time there was a little discharge from the sinus for about a week. The woman remained well for six months, but she is now (ten months after operation) suffering from symptoms of stricture, has occasional attacks of jaundice, colic, etc., and will have to be reoperated upon. Where there has been a large amount of scar tissue formation he did not see how stricture can be avoided, and unfortunately little has been written concerning the late results in reconstruction cases.

DR. ALEXIS V. MOSCHCOWITZ said that a few years ago he was interested in the subject of necrosis of the costal cartilages, and in looking up the literature he found a considerable number of cases had followed operation upon the gall-bladder and ducts.

DOCTOR MATHEWS said that he had had three cases in which the common bile duct had been damaged at operation. In the first case the patient had drained bile for eight months after operation. The sinus had finally closed and was followed by jaundice and occasional chills. She was in this state when first seen. Operation consisted only in reestablishing external drainage. Some days later hemorrhages began which were controlled for several days by transfusion. She died following the fourth transfusion. The second patient has been operated on three times by me and is now reasonably well. She had had three previous operations on the gall-ducts. He had never been able to quite demonstrate the pathological condition. The longest operation he had ever done—namely three hours and twenty minutes—was one of the three on this patient. The third case is the one shown this

evening. The method of reconstruction of the duct around a tube passed into the duodenum, as mentioned by Doctor Erdmann, has been frequently employed. In the case shown it seemed simpler and easier to bring the tube onto the abdominal wall through a small incision in the side of the common duct.

DOCTOR DOUGLAS, in closing the discussion, said that while in his case the result up to the present time had been excellent, it would appear that in a large number of these cases, as illustrated by one of those reported by Doctor Erdmann, the scar tissue which formed in repair again closed down, and it necessitated another operation or reconstruction of the duct; and that it would be interesting to follow a number of these cases which have been repaired by different methods to determine if one method had any advantage over another, and was less apt to result in cicatricial contraction. As, for example, the method reported by Mayo in which the duodenum is mobilized and brought up, and an opening therein sutured directly over the stump of the common or hepatic duct.

PULMONARY LOBECTOMY

DR. HOWARD LILIENTHAL read a paper with the above title, for which see p. 257. He also presented five patients whose cases are reported in the paper.

DR. PAUL W. ASCHNER (by invitation) read a paper entitled Pathology of Lung Suppuration, illustrated by lantern slides, for which see p. 321.

DR. JAMES MORLEY HITZROT said that his experience covered five cases of the type under discussion, one an abscess due to a bullet wound, one followed tonsillectomy, two followed some type of pleural infection, and one was a tumor of the lung—small round-cell sarcoma. There is one point in Doctor Lilienthal's paper to which he would particularly refer, namely, too early attempt at lobectomy in the cases which follow tonsillectomy. In one of his cases the operation was done twelve weeks after the onset of the symptoms. The left lobe was removed and the lung showed the miliary abscesses described by Doctor Lilienthal. The patient survived the operation, but the wound in the chest wall became infected and a rapidly sloughing gangrenous process caused her death from infection. He believed with Doctor Lilienthal that this may be avoided by delaying the operation.

In the case with the bullet wound he tried to take the lung out and was successful, but the man died of massive thrombosis, probably of the heart. The tumor case died five months after operation from metastasis. The others are well.

DR. WILLY MEYER said that after experimental work in lobectomy, resection of the lung in dogs at the Rockefeller Institute in 1908 and 1909 with seventeen recoveries in twenty-one operations, when they saw the dogs jumping around and loudly barking after three to four days with the empty pleural cavity filled with air in every instance, not with serous fluid as found by other investigators before, they naturally approached the subject of lung resection in man with great enthusiasm. He operated in the spring of 1910 at the Lenox Hill Hospital on a boy with advanced bronchiectasis of the left lower lobe. He proceeded as

he had done in the dogs: intercostal incision, rib spreader in place, separate ligation of the blood-vessels accompanying the bronchus. When he was ready to tie the crushed bronchus the anæsthetist reported the boy had died suddenly. He never found a satisfactory explanation of this death except by vagus reflex. Naturally, this experience was a damper on his enthusiasm. A few weeks later Professor Friedrich, of Marburg, came to America as the guest of the American Medical and the American Surgical Association. When told of this recent experience, he said: "Doctor Meyer, do not be too aggressive; do not extirpate suppurating lungs right away. Rather go slow. Thoracic surgery is just taking a hold on the medical profession, and if many patients die from lobectomy the whole new chapter might get a black eye. Try conservative operative measures first." Doctor Meyer had faithfully followed this advice—on looking back, partially to his satisfaction and partially to his regret—and carried out every conservative operation known in the surgical treatment of bronchiectetic lung abscess. He tried artificial collapse of the lung (artificial pneumothorax), ligation of the branch of the pulmonary artery, thoracoplasty, peroral endoscopic treatment (bronchoscopy) with aspiration, also irrigation of the bronchial tree by a specialist, and incision of the lung abscess. He also tried resection of the lung in five cases, but cannot show the results that Doctor Lilienthal has shown to-night. The last case referred to, a young boy with lung suppuration, required excision of the entire right lung. Pharyngeal anæsthetization was carried out. At one time during the operation the boy was very cyanotic. Pathological examination proved the cause of the suppuration to be lymphosarcoma. The patient stood the operation well but developed a high temperature in the night following and died. Autopsy was not permitted.

Some of these cases can be greatly improved, if not cured also, by other methods than resection of the lung. He saw satisfactory results in a case of ligation of the respective portion of the pulmonary artery, also after repeated endoscopic treatment, and after incision of the lung abscess. For instance, a young man with ligation of the branch of the pulmonary artery of the lower lobe, done eight years ago, is now comparatively well, expectorating not more, if any, than 15 to 30 c.c. of mucopurulent pus in twenty-four hours. He is married, lives in the South and attends to his business. A young girl with bronchiectasis subsequent to tonsillectomy came for treatment from California several years ago; she almost died during the journey across the continent. Doctor Yankauer bronchoscope her and found all three lobes of the right lung were involved. Radical operation was neither advised nor considered by her relatives. Doctor Yankauer used endoscopic irrigation at regular intervals. That girl has almost completely recovered and is now on the stage. In an early case of this type a young married lady, also subsequent to tonsillectomy, endoscopic treatment with aspiration, done at the Lenox Hill Hospital by Doctor Lynah, brought the high fever down to normal; there was such pronounced general improvement after one treatment that the patient left the hospital, though against advice.

A patient with bronchiectatic lung abscess in the right upper lobe, after aspiration during operation, was cured by pneumotomy. In a young man, who came under his care in a deplorable condition due to bronchiectasis of the left upper lobe with incised local empyema, conservative treatment, carried out with the intention of establishing a fistula, brought great improvement. The fetid expectoration stopped completely. Today he is able to ride a bicycle, has even dared to play tennis, is in business and happily married. He has a typical lung fistula and was emphatically advised against going on the water; nevertheless he has become an enthusiastic fisherman.

But it must be said and emphasized that in advanced cases of bronchiectasis, if one wants to have these patients completely recover, only resection of the lung can be considered.

DR. NATHAN W. GREEN said that it is a good thing to know that these distressing cases can be cured; 58 per cent. of cures is a very satisfactory showing considering the severity and the newness of this class of operations. In thoracic conditions the surgical question is flanked by physical and physiological problems that do not occur in abdominal surgery. These two classes of problems act as a right and left guard to keep us from attacking successfully the pathological centre. However, as we overcome them we are getting more toward the direct meeting with the problems of surgery in the chest. He understood that Doctor Lilienthal waits for about one year to be sure there is no tendency toward spontaneous recovery. Such delay is very desirable. Doctor Meyer mentioned the fact that he has tried different means before resorting to resection of the lung and he has had palliative results which are good. Thorough preparation both remote and immediate is essential. Doctor Lilienthal's efforts are reinforced by his organization of operating and nursing staff and he can do this special operation quickly which in many general hospitals cannot so readily be done because of the rotating staffs. That is a great help in this class of work. He speaks of thoracotomy as not being a severe operation. He could corroborate that; with a dose of morphine beforehand it can be done under local anæsthesia. But local anæsthesia is not advisable when manipulation of the thoracic viscera is contemplated. These operations should not be over an hour in length. Differential pressure should be always at hand and closed potential drainage of the Kenyon type should be employed. When the late Dr. H. H. Janeway and he were working on dogs they found that opening the pleural cavity for over an hour resulted in septic pleuritis.

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DRAINAGE*

BY JOSEPH A. BLAKE, M.D.

OF NEW YORK, N. Y.

As far as the drainage of wounds of the muscle planes is concerned the practice, as generally carried out, seems to be satisfactory and does not call for much improvement. During the war, the importance of dependent drainage was emphasized by our experience with gunshot injuries, but we also found that drainage was not necessary when there was no dead or necrotic tissue in the wound. It is well to bear this last fact in mind, for it is also true in infections of the body cavities and viscera. I am now speaking of drainage in the sense of employing tubes or other materials to produce it, or rather continue it; for we should make a distinction between an incision used merely to evacuate a cavity of the products of inflammation and perhaps allow these products to escape for a short time, and drainage continued for a longer period by means of drains. I shall use the term evacuation for the former and reserve drainage for the latter procedure. An illustration of the needlessness and, as I shall show later, the actual harm of drainage when there is no necrotic tissue remaining, occurs in the treatment of peritonitis. I called attention to this in 1903-04 † and at that time showed a marked difference in mortality in favor of non-drainage between drained and undrained cases of bad diffuse peritonitis. It is only fair to state that the high mortality followed introduction of drains through multiple incisions and also much handling of the viscera; yet subsequent experience demonstrated that the drains themselves by pressure and foreign body irritation, or presence, or whatever you may call it, kept up a peritonitis which otherwise would have subsided. At that time I made the rule that drains into the peritoneal cavity were unnecessary when, after elimination of the cause of a peritonitis, there was no great difference in the appearance of one part of the peritoneum from another. Thus, in an ordinary diffuse peritonitis no matter how bad the peritonitis, drainage was unnecessary, but in a localized peritonitis, as, for example, an abscess, drains should be used.

The same principle of non-drainage in diffuse infections without local

* Read at a joint meeting of the New York Surgical Society and the Philadelphia Academy of Surgery, November 7, 1921.

† Treatment of the Peritoneum in Diffuse Peritonitis, *ANNALS OF SURGERY*, August, 1903. The Treatment of Diffuse Peritonitis, *New York Medical Journal and Philadelphia Medical Journal*, November, 1904.

necrosis was found to hold true during the war in the treatment of infections of the joints. Early in the war I found that drains traversing the joints were fatal to the joint, and my results were greatly improved by using short drains which only entered the joint. Later on we all were struck with the remarkable results obtained by Wilms, who did not use drains at all, but after opening them relied on active motions of the joints for the prevention of accumulation.

In the treatment of empyema we have not as yet been able to demonstrate in so forceful a manner that drainage tubes are detrimental, yet I believe, if we could only insure some other method of keeping the wound in the thoracic wall patent, that much better results could be obtained than by the use of tubes. The nearest I have been able to get to this ideal is by the use of very short tubes; tubes just long enough to keep the pleural cavity empty. These tubes may be removed usually in four or five days, namely, as soon as the drainage tract is established; and in most cases the cavity is closed and the condition cured in ten to twelve days. On the other hand, if tubes traverse the cavity and are left in for longer periods, no matter whether they are slender Carrel tubes or tubes as big as one's thumb, they establish the infection which often becomes mixed in character and cause a more or less chronic sinus.

As I say, it would be better to leave tubes out if we could; but, in order to drain efficiently, the opening should be made just at the upper line of the costo-phrenic sinus, and if continued drainage is needed something must be introduced to prevent the diaphragm closing the opening. In some cases of empyema in which resistance to the infection was obviously active and in which there was extensive fibrinous exudate I have cleaned out the latter by hand through a large incision, and dispensed with drains and obtained immediate resolution.

There is no doubt but that evacuation of the products of infection by simple incision will suffice in many cases of empyema. It only remains to be able to select or rather recognize such cases. It is difficult to lay down rules by which such cases may be distinguished, but I believe it is safe to dispense with tubes if after evacuation no visible foreign material such as adherent fibrin remains. In such cases the secretions forming in the pleura will be serous in character and will escape through the incision, which should not be entirely closed by suture. In two or three days there will be no secretion and no drainage unless foreign materials such as drains are left in the chest. In other words, repair in the pleural cavity does not differ essentially from repair in a joint or the peritoneal cavity.

There is another class of drainage cases in which the question again arises as to whether the drainage we customarily employ is not detrimental in a similar way. I refer to drainage of the common bile duct in cases of cholangitis and more particularly when drainage is to be employed temporarily as is the case in the great majority. The usual manner in which drainage is accomplished is by introducing a tube into the duct. The tube may pass upward into the hepatic duct, or it may be a T tube, one limb of the T lying

in the hepaticus and one in the choledochus. The question is, should we, in view of our knowledge of the harmful effects of drainage tubes in prolonging and establishing infection, introduce tubes into the duct? Would it not be better to simply drain to the opening we have left in the duct? Closing of the opening in the duct thus dispensing with drainage has already been recommended and practiced; but when one has traumatized the duct, particularly if in the region of the papilla, or when pus is flowing from it, one hesitates to close it. An objection to draining only to the opening in the duct is that the bile flows into the peritoneal cavity before entering the drainage tube. This does not seem to matter, for we find it escapes around the tube even when the tube is introduced into the duct. When I have drained to the opening in the duct and not into the duct, it is my impression that the discharge has cleared more quickly with less suppuration and has ceased in a few days instead of often as many weeks.

There is another class of cases in which drainage of the viscus is not practiced frequently enough. I refer more particularly to cases of advanced peritonitis with paralytic ileus. How often the peritoneal cavity has been drained when unnecessary and the patient has died of ileus, often caused, it is true, by the drains in the peritoneum, but more often by toxic paralysis of the muscularis or a combination of paralysis and tubes. Most of us have saved patients by a secondary ileostomy. My plea is that it should more often be a primary operation. Not that it should be done in every case, but that it should be done more often. It is very easy. A soft catheter stitched with catgut to the margins of a small opening in the lower part of the ileum and then the wall inverted with a couple of purse-strings so that the stoma will close when the catheter is withdrawn is all that is necessary. The catheter may be withdrawn with safety after two or more days when the catgut stitch has loosened. There is no need of a Paul's tube or any other such formality. I have brought the catheter out of a buttonhole incision in the linea alba when I wished to close the operation wound completely.

There is still another type of drainage to which I shall apply the term *precautionary*; namely, drainage, which is used to prevent accumulation of wound secretions, or infection in case of visceral leaks. I have little or nothing to say of precautionary drainage of ordinary wounds to prevent accumulation of serum or blood, for I believe that the rules for this are sufficiently definite. Of course every surgeon of experience establishes his own, although the question is often debatable as to whether one should drain or not. As a protection against peritonitis caused by leaks there are two operations in which surgeons differ and in regard to which there is a grand opportunity for discussion. These two operations are cholecystectomy and resections of the colon. I believe a drain does no harm in these cases and will save lives. Gauze should not be used. A slip of rubber dam is sufficient. All that is necessary is a lead along which discharges may escape.

If retroperitoneal spaces are opened, and particularly if large as in retroperitoneal ureterotomy, drainage must be employed.

Before closing I must say a word about the materials used to produce drainage. In the first place, gauze is commonly employed, but never should be for drainage alone. Gauze is extremely useful as a packing in certain classes of wounds but is not a good drain and may be exceedingly injurious. In the first place gauze is an effective filter and consequently while the serous secretions may escape through it, it acts as a dam to the solid necrotic portions which form the food upon which bacteria grow. Gauze has been a woeful cause of death when used in gunshot wounds and in the peritoneal cavity. It has plugged up the secretions in one and acted as an irritant and cause of obstruction in the other. The indications for its use are, first, as a pressure hæmostat, and, second, to prevent the soft parts falling into cavities during the early stages of repair such as are formed in excision of joints or other operations upon bones. Except when used as a hæmostat it should be separated from the wound surfaces by rubber or other non-adhering material.

Rubber tubing is the material most commonly used for drainage, but is more often used than is necessary. The true indication is when large quantities of material, and particularly solid material, are to be evacuated. Thus we use tubing with reason when we drain the urinary bladder, the gall-bladder or ducts, or the intestines, and also when we drain wounds in which there is solid necrotic material which has to be evacuated by irrigating through the tubes. For these latter cases, the tubes should be large, for otherwise they may become blocked. When large it is very important for them to be soft as otherwise they may be dangerous through causing pressure necrosis. I shall never forget the sensational report by one of our members of a case of ligation of both iliac arteries because of hemorrhage produced by the pressure of drainage tubes used after a double ureterotomy for calculi. If solid matter does not have to be evacuated there is much to be said in favor of a number of small tubes such as the Carrel tubes, for they are not so likely to cause disagreeable pressure effects and they permit the use of irrigations. Also as the holes in tubes are usually blocked by the soft tissues, Chaput is probably correct in his belief that drainage takes place alongside of and about rather than through tubes. However, even if we agree with him thus far, we should not necessarily go to the point of believing that a bunch of silkworm gut is better for all conditions than a tube because there is more superficies to the many strands of gut than to the single tube. For precautionary drainage silkworm gut and folded rubber dam are excellent, for they do not produce pressure necrosis, they efficiently drain off fluid secretions and also form a sufficient lead along which larger drains may be inserted if developments demand them.

WAR INJURIES COMING TO SUBSEQUENT OPERATION

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It is not our intention in this report to review those post-bellum conditions operated in the last two years, as that would involve the perusal of more than 1800 operations. We have been able to improve many injury cases by means other than operation. Many had attained the maximum result before arriving at this hospital, the majority showing most excellent results, no doubt far surpassing the most sanguine expectations of the original operator, while in other cases the results must have fallen short of his expectations; especially is this true of nerve sutures, amputations and bone injuries.

It is not our intention to criticize war surgery, especially when we consider the circumstances under which most of the work was done; indeed the cases are few where we feel that the result obtained was due primarily to a lack of surgical knowledge.

The surgeon must follow his own individual mistakes and successes in order really to profit thereby, and it is only upon a broad surgical basis that a study of these post-war results can be instructive; unfortunately such study of results was not possible to the individual surgeon during the active war period nor subsequently when the cases were beyond his reach. All the cases reported are taken from our surgical clinic at the U. S. Public Health Service Hospital No. 35, St. Louis, Mo., covering the period between July 1, 1919, and June 30, 1921.

NERVES

Hospital No. 35 was organized rather late to get nerve injuries requiring suture; nevertheless, from our observation of end-results we are convinced that the successful nerve suture must be end-to-end anastomosis and that each severed end before suture must show normal fasciculi.

We have found it necessary to resect neuromata from the ulnar nerve in four cases, twice each in the upper arm and forearm; in each instance an incision was made through the centre of the neuroma, the ends sliced off until normal fasciculi were found, when an end-to-end suture was done, being careful not to twist either trunk. In one case it was necessary to acutely flex the wrist in order to bring the ends together, and in another this was made possible only by transplanting the nerve to the front of the condyle of the humerus. In each case we surrounded the suture line with fat or muscle; whether or not this is worth the time and trouble, we are not prepared to say.

It is rather too early to give end-results, but in no case when last seen

had the thumb adductors filled out to normal. Three of these injuries followed gunshot and one incised wound.

We have removed painful neuromata from amputation stumps fourteen times; in five from finger stumps; once each from the median, musculospiral, and radial; twice each from the anterior tibial, posterior tibial and ulnar nerves.

At first we made a practice of injecting the trunk of the nerve with alcohol to prevent further neuromata, but in many cases the resultant pain was so severe and persistent that we abandoned the method and now simply cut the nerve off as high as possible above its end.

In three cases we had to free nerves from scar tissue: An ulnar in the forearm just below the humeral condyle, causing severe pain and numbness and twice previously operated on, was freed for three or four inches and then surrounded by a free fat transplant, with immediate relief from pain; a perineal was freed from scar tissue near the fibular head, with relief from pain; a sciatic was operated two and one-half years after injury, with excellent results. In this case the patient had been injured in the Argonne, November, 1918, by shrapnel in right gluteal region; the femur had been fractured; control of leg and foot had been lost and later trophic ulcers and eczema had occurred on the external side of the leg; the knee had become partially ankylosed. At operation we found the sciatic nerve bound to the greater trochanter by very dense scar tissue. The nerve was freed, scar tissue removed from the trunk and then surrounded by a free fat transplant. In eight days the ulcers of the leg had healed and sensation returned to the external leg and toes; the patient is still improving.

KNEES

The knee has been the most frequent of the large joints requiring surgical attention. It has been necessary in this series to open the knee-joint twelve times, with no subsequent infections.

For the removal of "joint mice" and semilunar cartilages the Jones semilunar incision has proven the most practicable; the longitudinal splitting of the patella gives an excellent exposure of the joint in front of the crucial ligaments, but if there be a foreign body behind these it is necessary, as in one of our own cases, also to split the capsule transversely; the large curved transverse incision likewise gives excellent exposure, but occasionally leaves a relaxed patellar tendon. We have found it best to control hemorrhage as the operation progresses and to change gloves just before entering the joint and immediately after the towels are clipped to the skin edges; all sponges being handled by forceps.

All the cases gave a history of injury. It may be generally stated that the longer the period between the injury and the operation, the greater the pathological changes present and the less chance of complete recovery.

One knee which had previously been operated and had been stiff and

draining over a year and also thought to be tuberculous, immediately healed and completely recovered all motion, by simply removing a large sequestrum from the patella.

We have had to amputate one thigh because of a destructive process in an old resected joint. So far we have resected only one knee-joint as a result of injury and it proved to be tuberculous.

We have removed seven loose semilunar cartilages and eight "joint mice." The chief symptoms were pain, weakness, locking and sudden giving way of the joint. The X-ray was a great aid in diagnosis. All cases gave a definite history of injury.

The most instructive and satisfactory operation upon the knee was as follows: E. B. fractured his right patella October 15, 1919, and it was wired November 17, 1919. He was in bed three weeks. On February 2, 1920, in attempting to board a street-car he ruptured the wire sutures and separated the fragments; he was operated the second time February 11, 1920, when the joint became infected, and he was in bed ninety days; the knee drained six weeks and complete ankylosis followed. The patient visited several large clinics seeking relief; an attempt was made at one hospital to bend the knee under general anæsthesia. After admission to our wards, X-ray showed complete bony ankylosis. On October 15, 1920, we performed the following operation: Longitudinal external and internal incisions joined just below the tibial tubercle; no joint could be found; the bone was chiseled about three-fourths through and then broken; condyles were then shaped, the internal the longer, and excavations made in the tibia to receive them, leaving a large spine between; a large pedunculated musculo-fascial flap was then sutured in place to cover the new joint surfaces; the quadriceps tendon was then severed by a Z-shaped incision and lengthened so that the two parts of the patella could be wired together; another pedunculated flap was then sutured under the patella and the wound closed. A posterior splint with extension was applied for seven or eight days when very gentle passive motion was begun. Personal attention was given to this case for six or eight months. The patient at present has a useful and strong knee-joint; he can raise his weight up and down on this limb alone, walk up and down stairs, dance, etc.; he has 48-degree motion, with a good chance of greater range of motion in the future.

Other Joints.—We have successfully made a metacarpo-phalangeal joint for the index finger in one case and the ring finger in another; the scaphoid has been removed to obtain more motion in a wrist and one elbow-joint has been resected. Amputations following old joint injuries will be mentioned later.

Recurrent Inguinal Hernia.—Recurrent hernias may be considered as sequel injuries. We have no fair basis upon which to figure the percentage of these recurrences. In the two years covered by this report we have operated three hundred twenty inguinal hernias and of these fourteen were

recurrent following operation elsewhere and therefore do not properly belong to this same series.

As is the rule, the direct hernias had recurred most frequently. Three were double with recurrence on both sides and one was a double with unilateral recurrence.

In one recurrent on the right side we found the stump of an appendix which had never been invaginated and still produced symptoms. One case had a fecal fistula caused apparently by a needle puncture of the bowel, and it required several attempts before we were successful in closing it. In three cases very large sacs had never been removed and in one case the incision had been made only through the skin. One undescended testicle was found bound in a mass of scar tissue; in one case both testicles were undescended and it was necessary to replace one of these in the abdomen to relieve pain.

Other Hernias.—It was necessary to repair the anterior abdominal wall twenty-four times and the lumbar once. In practically all the abdominal hernias, adhesions of the bowel or omentum were found and freed. In twelve cases the hernia followed drainage of an appendix; in one, as a result of gall-bladder drainage, we accidentally opened up the old tract and soiled the wound with bile, but this did not prevent primary union and an excellent result.

We have used the Mayo overlapping method and have not hesitated to cut large flaps from the anterior recti sheaths when needed, always suturing the remaining edge of the sheath to the muscle to prevent a muscle hernia. We have used chromic catgut No. II in all cases.

The patient with the lumbar hernia was wounded October 27, 1918, by a high-explosive shell and was in the hospital until discharged from the Army. The back muscles on the right side between the ribs and ilium were shot away and only thin skin covered the bowel, allowing the cæcum to be picked up in the hand. In July, 1919, we freed the cæcum from the skin, replaced it in the abdomen and transplanted fascia lata from the thigh to the back; this with the scar tissue present gave him a strong and useful back free from pain.

Muscle Hernias.—Débridement no doubt saved many lives and many limbs; this, however, was the chief cause of muscle hernias, which, in our experience at least, is a new cause of post-bellum disability; we believe that muscle hernias were rather rare before the war.

Weakness and pain are the chief subjective symptoms; objectively the diagnosis is easy and treatment is simplicity itself. The edges of the fascia should be well freed before suture.

In clean cases when it becomes necessary to remove for transplanting a part of the fascia over a muscle, hernia can be prevented by suturing the remaining edge of the fascia directly to the muscle.

We have repaired twenty-three muscle hernias in sixteen patients. It is interesting to note that eleven of these patients received their primary wounds

in the Argonne. All the hernias were of the muscles of the lower extremity. The fascia lata over the external thigh was repaired eight times; over the quadriceps, nine times; over the external belly of the biceps femoris once; over the tibialis anticus three times and the lumbar fascia twice. The back cases were most extensive; here the fascia had been split transversely across both sides and part of it removed; in each were foreign bodies requiring removal and in one case the erector spinæ had been severed and partly removed.

Foreign Bodies.—Many symptomless foreign bodies were located which we did not molest, while a few were removed for the psychic effect. One in a silent area in the brain, one in or near the heart with no symptoms, one in the centre of the liver, and two in the lungs we thought best to respect and leave alone on account of the seriousness of the operation involved.

In only two cases were we unsuccessful in removing the foreign body. All were previously located with the X-ray and upon several occasions it was necessary to use the fluoroscope during the operation. Local anæsthesia can be used in practically all cases of foreign body. This gives the operator the advantage of leisurely searching for hours if need be and with the coöperation of the patient.

The majority of the foreign bodies have been high-explosive shell fragments or bullets. We have found gauze packing, wood knife-handle, etc. Practically all foreign bodies were claimed by the patient as souvenirs, which prevented our making a collection. We have removed one or more foreign bodies from thirty-five patients as follows:

High-explosive shell fragment	24
Bullets	7
Wood (knife handle)	1
Gauze drain	1
Piece of emery wheel	1
Needle	1
They were removed from the	
Head and neck	6 times
Upper chest	2 times
Upper extremity	5 times
Body	8 times
(Of these seven were removed from the posterior region and two from in front of the sacrum.)	
Lower extremity	6 times
(One each from tibia and fibula.)	
Near shoulder joint	4 times
(Two under clavicle near ribs; one from spine of scapula and one in front of body of scapula.)	
Place not mentioned	4 times

Fourteen of these patients were wounded in the Argonne and fifteen had been operated previously.

Skull Injuries.—Considering the number of skull injuries seen, only a few required operation.

We are convinced that bone grafting to cover defects of the skull is not a proper surgical procedure. A bone graft requires stress in order to be a success. A bone graft of the skull lives about two years, either becoming absorbed or its edges becoming rarified, and requiring removal on account of irritation. Cartilage seems to be the proper material to use; it is easily obtained, shaped and sutured to the periosteum over the defect and upon the edges of the bone instead of the dura. Coughlin, of St. Louis, has proved such cartilage transplants live in the skin for twenty years. The chief symptoms relieved are dizziness and throbbing headache.

We have grafted cartilage over skull defects in three patients; two of these had been bone-grafted nearly two years before; the other had a large defect, with scalp adherent to dura. Two of the patients were epileptics, but the convulsions were not much relieved, although the headaches and dizzy spells were alleviated.

One skull injury presented a pulsating tumor over the longitudinal sinus following a high-explosive shell wound; at operation this proved to be a cirroid aneurism of the temporal artery, which we removed.

An attempt to drain an abscess of one year's duration was followed by meningitis and death. The interesting part is that the abscess was not suspected and was discovered at operation.

Other Bone and Cartilaginous Grafts.—We have used only autogenous grafts and the tibia has been the favorite source. We prefer the inlay method. Kangaroo tendon and chromic gut are preferable to beef-bone screws, although the latter are more easily handled when properly made.

The cases requiring bone grafts have been difficult and had previously been operated with much resultant scar tissue, etc. We have had to graft two humeri, two ulnæ, one radius, one superior maxilla and three spines, following injury.

One patient, a great friend of John Barleycorn, refractured a united medullary graft of the humerus and obtained another false joint. In another case it was necessary to remove one bone graft of the humerus which had failed to unite; good approximation of the ends was obtained, but the patient left the hospital against advice and has failed to report back as promised. (Another friend of John Barleycorn.)

One of the ulnar grafts bridging a two and one-half-inch defect became infected; nevertheless the graft lived and new bone united the ends, using the graft as a bridge and growing along its side. A false joint following a fracture of the ulna and radius very near the elbow-joint was especially difficult but successful.

The three bone grafts of the spine were successful and the patients are up and about again. We did not split the spinous processes, as in the Albee operation, but denuded the left sides completely and fastened the graft to the denuded side of the spines with kangaroo tendon through drill holes. Body casts, split down the sides and known before operation to be comfortable, were applied at once and worn for months.

The cartilaginous graft of the superior maxilla was especially instructive and gave an excellent result. A piece of cartilage was removed from the chest, shaped like a tennis racket, the handle for the zygoma, and then sutured to the remaining root of the zygoma and edge of the orbit through drill holes; the scar tissue and skin were then sutured over it. Later the ear was built up by a cartilaginous transplant and the boy departed, happy that he could again associate with his friends without embarrassment.

Correction of Deformities.—Deformities resulting from injury have been corrected for eleven patients. One of the worst deformities of the leg we have seen followed fracture of tibia and fibula at the junction of middle and lower third, which had been operated, a Lane's plate applied and the patient had been permitted to be up too soon. The leg was Z-shaped and the patient in an undesirable psychic state because he had been "turned down" at several hospitals and at the "largest clinic in the United States." An open osteotomy, with nearly a year's personal attention, gave him a leg, as the patient writes, "surpassing our most sanguine expectations."

We had two chronic dislocations of the shoulder-joint: one, a blacksmith, has been following his trade over a year without recurrence, who was treated by simply imbricating the capsule; in the other, which would dislocate even when patient sneezed, it was necessary to split the capsule and overlap it. The anterior incision was used with chromic gut No. II as suture material in both cases.

Tenotomies of extensor toe tendons were done four times and of the tendo Achillis three times. A deformed metacarpal, following fracture, was corrected by open osteotomy and extension; and a cervical rib removed in a patient previously diagnosed at different hospitals as having neurasthenia, psychoneurosis, paraplegia, rheumatism, pellagra, chronic malaria, bone tumors of the back, syphilis and osteitis; the X-ray soon revealed the actual trouble.

Stumps.—During this period we have had twenty-five stumps to repair or reamputate on account of pain and non-healing and in order that artificial limbs might be comfortably worn. This occurred in the leg eleven times, thigh five times, forearm four times, arm two times, fingers five times. Fourteen of these patients complained of pain; three had an osteitis of the ends of bones; seven had spurs on the ends of bones; one had a foreign body and one a piece of silkworm gut; seven had painful neuromata; six had ulcerated stump; three had too-short skin flaps; three had painful scars, requiring removal.

Post-operative Adhesions.—Had we operated all cases diagnosed as peritoneal adhesions our list would, figuratively speaking, be legion. Nevertheless, in a few cases the diagnosis has been definite and operation has relieved the symptoms. Eight of the cases followed appendectomy; in all, the chief symptom was pain; one had not been free from pain for two years. The cæcum and omentum were involved in all; there was a hernia in three; a stump of an appendix was found in one.

One case had an obstruction of the bowel following an abdominal bullet wound. We found a band the size of a lead pencil reaching from the anterior abdominal wall to the spine with a loop of intestine about it; a band of omentum was also found fastened to the sacrum and two loops of bowel "hooked" together by adhesions; it was only by the freeing of this last that we were able to release the gas and it was not necessary to resect.

Another abdomen was injured by a horse falling upon the patient; the spleen was ruptured and appendix was removed. The patient suffered greatly and later another operation was done for adhesions and hernia, but this had not relieved him. We found the cæcum and ileum bound to the anterior abdominal wall and the ileum bound to the cæcum in such a manner as to cause an acute kink at its junction with the large bowel. The adhesions were freed and the hernia repaired, with complete relief.

Another abdominal injury had been diagnosed psychoneurosis on account of the neurotic symptoms. We found the omentum and transverse colon bound to the liver. They were freed and replaced in proper position, with relief to the patient, who is now again following his profession as a dentist.

Scars.—One would expect many disabling scars in this class of patients, but this has not proven true in our clinic.

We have freed the flexor tendons of a wrist, the biceps tendon of an arm, also scar tissue about an elbow preventing motion and once the shoulder-joint, preventing abduction of the arm.

Painful scars have been removed from the first two fingers; from over the greater trochanter where a free fat transplant was made; from the groin in which a tuberculous stump of a spermatic cord was found and removed; from over the tibia in two cases and from the dorsum of the foot in one. In a painful scar of a herniotomy wound we found a silk suture causing the trouble. In one case a nerve was caught in a wound of the thigh. One case was unique: The patient suffered an X-ray burn of the heel and tendo Achillis when his ankle was examined for fracture; this had left a painful ulcerating scar which would not heal and had been unsuccessfully skin-grafted. After dissecting out the ulcer, we made a pedicle skin-graft from the opposite thigh to the heel, holding the parts in place for a week with a cast. The patient has been using the foot now for nearly a year: A short time ago we had the pleasure of seeing this graft, which still retained its pad of fat and hair was growing upon it. Skin grafts to be successful should be taken from above the knee or the elbow.

Amputations.—It has required a nicety of judgment to decide when and when not to amputate, as the patients are frequently much more radical than the doctor. Many who have waited patiently in the hospital for months and who see their friends recover and leave are anxious to settle the matter at once, and some few have attempted to secure amputation elsewhere after being advised to wait longer.

In children who stand chronic infection better it no doubt pays to be ultraconservative, but the adult who has fought infection for two or three

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years and cannot be promised more than a slim chance of a fair limb in some two or three more years of hospital life with the added danger of organic changes in the liver, kidney, heart, etc., and who can be put back to a gainful occupation at once with an artificial limb (especially where his disability will be about the same under the most favorable outcome), is allowed to decide the question of amputation for himself. Amputation was chosen in all but one case.

We have amputated eight fingers and one toe on account of contractures and ankyloses; the thigh three times, once because of a rupture of the femoral artery during a dressing, once because of a destructive process in a resected knee-joint and once because of a chronic infection of the knee-joint; the leg, three times due to destroyed ankle-joints following infection; the arm and forearm once each; a shoulder girdle because of a sarcoma of the scapula following injury and a hip-joint with the head and neck of the femur destroyed. This last case was especially difficult and interesting as follows:

B. K. received multiple gunshot wounds of the upper thigh and abdomen July, 1918, in the Vosges Mountains. A few foreign bodies were removed at once and in a few days he was sent to a base hospital and then to Bordeaux in August, 1918. On the train he had a severe hemorrhage and was transfused; seven days later was operated and the head and neck of femur removed and cast applied. He was sent home December, 1918, and operated again January, 1919, for a chronic osteomyelitis of femur and ilium. Was in the hospital five months, but the wounds did not heal. He was operated again in May, June and August, 1919, and then transferred to another hospital and operated again in September, 1919, but without improvement. He was then discharged from the army and sent to Chicago in October, 1919, and later to Hospital No. 35 in December, 1920, while still draining.

X-ray examination showed the head and neck of femur gone and osteomyelitis of the ilium and greater trochanter with a foreign body in the pelvis surrounded by bismuth paste; the limb was shortened, motion limited, leg cold and indurated, muscles atrophic, skin shiny, knee and ankle ankylosed, and part of the brim of the pelvis gone. We amputated at the hip-joint February, 1921; on April 7, 1921, we removed the foreign body from in front of the sacrum and, on April 25, 1921, we cleaned out the acetabulum, both operations under local anæsthesia. The patient was immediately permitted to be out of bed, gained weight and was discharged. A small sinus still occasionally drains bismuth.

Osteomyelitis.—There has been no post-bellum condition following injury giving more concern and requiring more care and attention than osteomyelitis; and as the patients usually arrive at the hospital discouraged and often debilitated from long-continued infection, we know no class more pleased and appreciative when they go home cured unless it be the surgical staff.

The cure of osteomyelitis depends more upon unfaltering care and

attention after the proper "cleaning up" than upon any new and wonderful operation or method of treatment.

In general we have followed the simple plan of removing *all* diseased bone with mallet and chisel (no matter where the diseased bone, it should be followed to the bitter end and the cavity well saucerized), swabbing the cavity with iodine and packing with gauze. The wound is then daily dressed and repacked and permitted to heal from the bottom only. It has occasionally been necessary to skin-graft healthy granulations and, under favorable circumstances, we have been able to save much time by filling the bone cavity with muscle or skin.

We have been especially pleased in certain patients, where the general resistance was low, the wound sluggish and not responsive to treatment, to see them change as if by magic and the wound heal, by simply receiving a few doses of typhoid bacilli intravenously, beginning with 50,000,000 and increased according to reaction. We have used typhoid bacilli as a foreign proteid since 1913 and so far have had no occasion for regret, although upon two or three occasions we have been somewhat worried, and it is well, when starting a new course of injections after an interval, to begin very carefully.

We have operated one or more times upon fifty-two patients with chronic osteomyelitis following injury; all had been previously operated, one as many as fourteen times. In these cases the injury was caused by high-explosive shell fourteen times, by machine-gun bullet four times, by gunshot wound ten times, by horse kick two times, by bayonet wound one time, by external violence eight times, not mentioned thirteen times. In seventeen cases the bone was fractured. The tibia was involved twelve times, the scapula was involved three times, the metatarsal was involved three times, the fibula was involved one time, the femur was involved fifteen times, the humerus was involved five times, the skull was involved one time, the ilium was involved two times, the ribs were involved three times, the os calcis was involved three times, the ulna was involved one time, the radius was involved one time, the metacarpal was involved two times, the carpal was involved four times, the sacrum was involved one time. Twenty of these patients were injured in the Argonne. There was a hole through the bone eight times, Lane's plates were removed two times, other foreign bodies were removed three times, tuberculosis was suspected two times.

Miscellaneous.—It has been necessary to do one cholecystenterostomy following drainage of a gall-bladder of several months' duration; to correct a retroversion of uterus in one patient and to remove a cystic ovary with a repair of the perineum in another; the former was injured by a horse, the latter injury we have not been able to connect with service: We have removed a large fibroma(?) of the forearm following injury and explored a large post-peritoneal sarcoma following the removal of an injured testicle and have removed another injured testicle which proved to be sarcomatous; a large inflammatory tumor following gunshot wound of left knee was removed.

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We have twice unsuccessfully attempted to repair the sphincter ani of one patient, which had previously been severed in three different locations.

One patient who gave the history of having fallen into a trench and injured his back and who was sent to the hospital, diagnosed inguinal hernia on account of a swelling in the right groin, was relieved of all symptoms by anchoring a floating kidney.

In the above superficial presentation of these post-war injuries it has been impossible to dilate upon the individual cases, some of which gave most interesting histories of what happened to them both upon the battlefield and later in the hospitals in France or as prisoners in Germany. It no doubt will be still more interesting in the distant future to be able to combine the army and navy records with our own and follow the cases to a ripe and happy old age.

THE TREATMENT OF SURGICAL TUBERCULOSIS WITH THE CARBON-ARC LAMP

BY PAUL KURT SAUER, M.D.
OF NEW YORK, N. Y.

IN the early part of 1917, when the writer was in Copenhagen, his attention was called to the treatment of surgical tuberculosis at the Finsen Lysinstitut by means of the carbon-arc lamp. Dr. Axel Reyn, the director of the Finsen Institute, and Dr. N. P. Ernst had been treating this type of cases with great success for several years, and both were very enthusiastic in their support of this form of treatment. Some of the cases treated were of long standing and the results achieved truly remarkable. It is the purpose of this paper to give a short account of this form of treatment. Some of the cases were treated at the Lenox Hill Hospital where two lamps have been installed.

The lamp (see illustration) is a twin-arc lamp with a reflector, and the arcs connected in series. A current of twenty-five amperes and one hundred and ten volts passes through these carbons, thus giving each carbon half of the voltage. The carbons are not enclosed in glass but emit their rays directly on the patient. A special chemical-core carbon is used to produce the desired rays.

The treatment consists in placing the patient before the light and exposing the affected part and as much of the surrounding area of the body as possible. Since the effectiveness of the rays decreases as the square of the distance from the light, it is obvious that the nearer the patient is to the light the greater the benefit. As the skin becomes more deeply pigmented and the heat from the lamp is better borne, the patient can be quite closely approximated to the lamp. The time of the exposure varies with the age, sex, and pigmentation of the patient. As a rule an adult male of dark complexion can be started with a half-hour exposure. Children should not be exposed more than fifteen minutes at first. After three or four treatments, each a little longer than the preceding, exposures up to an hour and a half may be given. At least three treatments a week should be administered.

About eight or ten hours after the first treatment a deep erythema is noticed. This may be uncomfortable for a few hours, but not more so than a sunburn acquired while at the beach. If too long an exposure is given the first time blistering may result. After two or three treatments desquamation will take place and later pigmentation will result. While the patient is under the light his respirations become slower and deeper, but the pulse-rate and volume are not materially changed. There is no marked alteration in the blood count.

Marconi states that he noticed local sweating around the wounds in treating these cases, but I have not noticed this, as the patients perspire so pro-

fusely that the entire exposed surface is about equally covered with perspiration. The effect on wounds with sinuses is identical with that noticed by Lovett in the Thézac-Porsmeur method of treatment.

The carbon-arc lamp has several advantages over the natural sunlight in the treatment of these cases. The patients need not go to sanatoria at the seashore or to high altitudes in order to get the effective rays. (These rays are usually filtered out by the dust and smoke at low altitudes.) The weather need not be depended upon; for in this way no treatment days are lost. What is probably more important, however, the patient need not stop his work in order to get the benefit of treatment, and can still live at home.

The mercury vapor-quartz lamp, while more economical in operation, is more costly and not as effective. Reyn has tried this lamp without much success and has given it up in favor of the arc lamp. The rays from the quartz lamp are almost entirely of the ultra-violet end of the spectrum, not very penetrating, but highly irritating. The quality of the rays, furthermore, is not constant, as the lamp becomes weaker with usage.

The Röntgen rays, while perhaps just as effective in the treatment of tuberculous cervical adenitis where the glands have not broken down, is not as effective in the treatment of tuberculous sinuses. It is also much more dangerous and must be handled by a specialist. Even then, as Baisch reports, burns sometimes do not appear until years after the last treatment. There is no danger of burning with the arc light except insofar as the sun is liable to cause burns, and the lamp may be used by any one with absolute safety to himself and the patient.

REPORT OF CASES

A. H. W., waiter, fifty-four, was admitted to the Lenox Hill Hospital on March 23, 1917, complaining of a small lump at the right costal border. The tumor was firm, but slightly fluctuating, and not tender. At times slight pain is noticed in this area, and the patient is not able to sleep on that side. The tumor has been getting larger for the last ten months. Except for pneumonia at the age of twelve and again at fifty, and typhoid at the age of twenty-two the past history is negative. Venereal infection denied. Except for the tumor the physical examination was negative. On March 24, 1917, about two inches of the cartilaginous and osseous portions of the eighth rib were resected. (Pathological diagnosis: Tuberculous osteitis of the rib.) After three or four months the wound closed. In the latter part of September the wound reopened, and was not healed until June, 1918. In March, 1919, the wound again opened and he was admitted to the hospital on December 12, 1919, as the wound had not healed up to that time. Reoperated on December 17, and on February 6, 1920. At this operation portions of the ninth, tenth, and eleventh ribs were resected. On June 11, 1920, the light treatments were begun. At that time two sinuses each about four inches in length were present. One opening was just to the right of the xiphoid cartilage and the other about an inch toward the nipple line. Rough bone of the sternum was easily felt with a probe. Blood count showed red blood-cells 4,330,000, white blood-cells 7400, hæmoglobin 90 per cent., polymorphonuclears seventy-four per cent., lymphocytes twenty-six per cent. The urine was negative. On July 21 the median fistula has healed. In September the patient claimed his general well-being was better than it had been in several years, that he had no more pain at

the site of the fistulas, and that he could now sleep with comfort on that side. The last fistula was healed on October 12, 1920, and he was discharged from treatment on December 15, 1920. When last seen in July, 1921, he had had no recurrence of any symptoms.

J. F., orderly, forty-nine, was admitted to the Lenox Hill Hospital on June 10, 1918, with an abscess of the left side of the neck. Operated upon June 13 for tuberculous cervical adenitis with abscess formation. A small draining fistula persisted when he was discharged in July. He was again operated upon in November of that year as the fistula had not healed and another abscess had formed. At this operation most of the glands were removed, and he was discharged with a draining sinus in February, 1920. When he was first treated with the arc light in October the sinus was not yet healed and a slight amount of secretion persisted. Just behind this sinus at the anterior border of the sternomastoid muscle a small group of glands about the size of a walnut was noticed. There was some pain in this region associated with movements of the head, and some tenderness on pressure. In December, 1920, the patient stopped treatments but resumed them again in February, 1921. In March the mass had disappeared, the pain had ceased, and the sinus was completely healed. When last seen in July, 1921, the patient had had no recurrence of symptoms.

R. H. W., secretary, forty-seven, was operated upon on November 30, 1920, at the Lenox Hill Hospital for a left tuberculous kidney (nephrectomy). After a stormy convalescence she was discharged from the hospital on January 30, 1921, with three draining sinuses. The sinuses were very slow in healing and light treatments were begun on March 12, 1921. On May 9 the patient discontinued treatments. At that time two fistulae were completely healed and a small scab had formed over the third fistula. The drainage from the last fistula was negligible. The patient wrote in July that the fistula had not yet closed.

W. G., clerk, thirty-nine. For the past five years the patient has been suffering from tuberculous sinuses on the anterior chest wall, one or more of which have been open all the time. About three years ago the axillary glands became involved to such an extent that they broke down and five sinuses made their appearance. On July 13, 1918, the sinuses were curetted and packed with iodoform gauze. The pathological report confirmed the diagnosis of tuberculosis. The X-ray showed no bone involvement. On physical examination slight dullness and a high-pitched percussion sound were noted over the left apex, anteriorly and posteriorly. The left pectoralis muscle is more prominent than the right, is stiff, and has a wooden feeling. There are three sinuses in the mid-clavicular line, one at the level of the second rib, and two at the level of the third rib. In the left axilla there are five fistulae. The urine is negative. Red blood-cells 4,350,000, white blood-cells 9600, polymorphonuclears sixty-two per cent., small lymphocytes thirty-one per cent., large lymphocytes six per cent., basophiles one per cent. This patient began light treatments in June, 1920, and has not responded to the treatment except that one fistula in the axilla is healed. He claims that he feels somewhat better generally, but as his mentality is of quite low grade his statements are unreliable.

J. B., watchman, forty-two. Admitted to the New York Skin and Cancer Hospital on February 8, 1921, complaining of a small, slightly painful and tender lump on the right side of his neck along the anterior border of the sternomastoid muscle, of seven months' duration, which was gradually increasing in size. Has had no night-sweats, but has been hoarse for the last four years, and coughs moderately in the mornings. About six years ago the glands on both sides were removed. After an operation for a tuberculous abscess he was discharged with an open sinus on February 19, 1920. He was readmitted on April 25, 1921, with an oval-shaped ulcer and a discharging sinus at the site of the previous operation.



FIG. 1.—Twin-arc lamp.

THE CARBON-ARC LAMP IN TUBERCULOSIS

Operated upon again and the sinuses curetted and packed. He was discharged with an open wound on May 2, 1921, and began the light treatments at the Lenox Hill Hospital on May 5, 1921. By the end of June the wound was entirely closed and the patient was free from all symptoms. Notwithstanding repeated admonitions to continue the treatments the patient has stopped coming.

M. H., office worker, twenty-one. (Referred by Dr. Nathan Green.) Admitted to St. Luke's Hospital on June 4, 1920, complaining of swelling of the abdomen. Operated upon by Doctor Green for tuberculous peritonitis, and fluid evacuated. Red blood-cells 3,600,000, white blood-cells 7900, polymorphonuclears sixty-two per cent., lymphocytes thirty-eight per cent. Urine acid, 1030, faint trace of albumin, a few casts, and some white blood-corpuses. She was discharged from the hospital on June 19th, with four sinuses in the operation scar. From then until March, 1921, she was treated in the out-patient department, and with X-ray without any material benefit. In March she began light treatments, and noticed that in June she was free from all pain. One sinus (the lowest one) had healed. July 12 all sinuses were healed and the patient was discharged on August 9, 1921. She has had no more pain since June and has gained sixteen pounds since beginning the light treatment. There has been no accumulation of fluid in the abdomen.

A. McC., housework, seventeen, came to the out-patient department of the Lenox Hill Hospital in August, 1920, complaining of ulcers on her anterior chest wall, of two years' duration. Various forms of treatment had done no good. One ulcer was over the sterno-clavicular joint and two others below along the left border of the sternum. X-ray showed no bone involvement. Wassermann was negative. The axillary glands were not palpable. Urine normal. Blood count showed nothing of any moment. After one hundred and forty exposures all three ulcers had healed and the patient was discharged.

TABULATION OF CASES

Case No.	Initials	Sex	Age	Diagnosis	No. of treatments	Total hours	Results
1	A. H. W.	M.	54	Tbc. osteitis	70	54	Cured
2	J. F.	M.	49	Tbc. cervical adenitis	53	39	Cured
3	R. H. W.	F.	47	Tbc. kidney	25	16	Improved *
4	W. G.	M.	39	Tbc. axillary adenitis	160	108	Unimproved
5	J. B.	M.	42	Tbc. cervical adenitis	24	18	Improved *
6	M. H.	F.	21	Tbc. peritonitis	40	30	Cured
7	A. McC.	F.	17	Tbc. of chest wall	140	105	Cured

* Patient stopped coming for further treatments.

CONCLUSIONS

1. The carbon-arc lamp is an effective agent in curing cases of surgical tuberculosis.
2. It is as effective as the natural sunlight and has the advantages of convenience and independence of the weather.
3. It is just as effective, if not more so, than the X-rays without the attendant dangers.
4. It is far more effective than the quartz-mercury vapor lamp, as has been amply demonstrated by Reyn.

TUBERCULOUS ABSCESES OF THE CHEST WALL*

BY HUGH AUCHINCLOSS, M.D.

OF NEW YORK, N. Y.

NINE cases are presented in this review. One case, a Chinaman, died shortly after admission to the hospital. One case, but recently admitted, has not been operated on, and is presented as a clinical example of the subject and not a result.

Some of the case histories are very long. In reporting them, an attempt has been made to focus on the chest wall condition, and cite as briefly as possible the other associated lesions, except where these lesions are of unusual interest. The ages of the patients varied from four and a half years to sixty-two. The duration of abscess was from two weeks to eight months.

Symptoms: A soft swelling on the chest wall, possibly preceded by a period of slight discomfort, slightly tender to pressure, fixed to the deeper parts, sometimes beneath the pectoralis major, its superficial portion somewhat movable when the muscle is relaxed, but firm, and fixed when the muscle is taut. It is usually evidently fluctuant.

The general health is below par; there may have been loss of weight, the picture may be that of an associated condition. There is some secondary anæmia with no leucocytosis. There may be little or no temperature rise. The X-ray may show dense shadows beneath the lesion, and sometimes evidence of calcification.

Location—usually in the anterior axillary line, low down—in the third interspace close to the sternum, or beneath the pectoralis major muscle. Seven of the nine were on the left side. The two on the right side were associated with Addison's disease, probably a coincidence, though their X-ray plates are strikingly similar.

Etiological Factors: Three cases were associated with cervical and axillary lymph-node enlargements. Seven cases gave a history of either influenza, or some form of respiratory disease, the description of which resembled pneumonia or a pleurisy with effusion, or encapsulated empyema. Four, and possibly five, had pulmonary tuberculosis.

Pathology: An attempt was made to prove the rib to be the distributing focus for the abscess. It was thought that this would prove to be the case in most instances. It is impossible to state that it may not have been in these cases and not discovered. Ribs were found tuberculous in two of the cases, but only after they were removed at secondary operations. Staining inequality in the costal cartilage of one case was found. In no case was rib removed at a primary operation found to be tuberculous. No contention is made that such is the rule, for it is well known that a rib may act as such a dis-

* Read before the New York Surgical Society, October 26, 1921.

tributing focus. On the other hand, the assumption that a tuberculous abscess of the chest wall is nearly always from a "tuberculous rib or sternum," an assumption that is rather general, is probably untrue.

Six abscesses were of the "collar-button" or "dum-bell" variety. A subcutaneous or submuscular abscess communicated by a narrow sinus through an intercostal space with a cavity or cleft beneath the intercostal muscles, and their adjacent ribs between them and the lung. This deep space corresponded to the pleural layers. Four cases that were cultured showed sterile fluid and positive guinea-pig inoculations. One pulsating empyema *necessitatis* grew out hæmolytic streptococci and contained tubercle bacilli that were recovered from a guinea-pig. One case was not cultured but had a positive guinea-pig inoculation. One case showed tuberculous granulation tissue but no cultures nor guinea-pig injection were done. Very extensive calcification of the pleura occurred in the two cases of Addison's disease. In one of these tubercle bacilli were recovered from a guinea-pig, whereas a diagnosis of chronic inflammation and not tuberculosis was made from the tissues of the abscess wall. In the other case the wall had probably been the site of an old localized empyema that had healed with extensive calcification and absorption of the abscess. This was the Chinaman with extensive tuberculosis of both adrenals, and whether the lesion in the chest wall was tuberculous or not remains somewhat in doubt. This Case III and Case IX † are the only ones in doubt, however, and Case VII is included because of its striking similarity to Case VIII.

Associated Conditions of the Nine: 1. Enlarged cervical and axillary nodes. 2. Enlarged cervical nodes removed one year previously. 3. Chronic pulmonary tuberculosis. Tuberculous empyema found after his second operation, but quite possibly latent previously. 4. Hæmolytic streptococcus pulsating empyema *necessitatis* following right upper and left lower lobe pneumonia; pulmonary tuberculosis. 5. Pulmonary tuberculosis; tuberculosis of elbow joint; tuberculous peritonitis; Pott's disease; tuberculous psoas abscess. 6. Tuberculosis of axillary lymph-nodes. Addison's disease; tuberculosis of mesenteric lymph-nodes. 8. Addison's disease. 9. Pulmonary tuberculosis; syphilis.

Rationale of Treatment: Surgery can be of real value in these conditions, but it will fail without certain precautions.

1. Before operating the general condition should be improved as far as possible.

2. Associated lesions should be looked for and if pulmonary tuberculosis is found, as much as can be done should be done under local anæsthesia.

3. As much of the abscess wall as possible should be excised by clean dissection and as much tubercle tissue removed as is practical. The principle to be followed is to bring as much uninfected and well-nourished tissue as possible in apposition on closing the wound. Such rib excision should be

† Since proven tuberculous.

done to expose an intercostal sinus and its underlying cleft or cavity and the walls of the latter excised gently but as completely as possible with a sharp curette. A small amount of iodoform powder may be smeared over the remaining wall.

4. The dead spaces should then be obliterated as far as possible. This is difficult in the deep cavity, but is aided by rib removal, and in the cases beneath the pectoralis major the origin of the pectoralis minor from the ribs may be severed and the muscle fibres, with their blood supply preserved, inserted into the cavity. The pectoralis major is sutured where it has been split and the skin incision closed either completely, or if there is much oozing, with small drains just through the skin. Blood is expressed from the wound as far as possible and pressure applied over the dressing by a large chest adhesive strapping and a temporary snug bandage outside. Every effort should be made to secure primary closure, and it is well, if possible, to avoid dressing the wound for twelve to fourteen days unless otherwise indicated.

A persistent course of anti-tuberculous treatment should then be begun and carried out for months and years.

CONCLUSIONS

1. Tuberculous abscesses of the chest wall are frequent enough to be of importance to the general surgeon, yet rare enough for many surgeons not to have had enough cases for study as to their pathogenesis and treatment.

2. There is a widespread opinion that such cases are, in the majority of instances, due to a "tuberculous rib" as the distributing or "primary" focus. The cases studied would indicate this not to be the case. The ribs did not show tuberculosis except after pieces of them had been removed and continuation of the tuberculous infection had occurred with secondary infection.

3. The distributing focus for the abscess seems to be from those structures immediately beneath the bony, cartilaginous or muscular chest wall. The lungs, the pleura and the mediastinal lymphatics seem preëminently responsible. The abscess is frequently deep as well as superficial to the chest wall; *e.g.*, the "collar-button" or "dum-bell" abscess.

4. The abscesses occur chiefly on the antero-lateral aspects of the chest wall rather than posteriorly.

5. The associated tuberculous lesions are varied in number and importance. They may or may not be more important than the abscess.

6. An extraordinarily large amount of calcium deposit may be present. The X-ray plates showing calcium are rather characteristic.

7. The story of influenza or an acute pulmonary condition may determine the onset of the abscess formation.

8. As complete excision of the tuberculous focus, leaving vascular, well-nourished walls to come together, with filling in dead spaces by muscle and pressure bandage and primary closure of wound is the treatment, though this may have to be modified by an associated lesion.

TUBERCULOUS ABSCESES OF THE CHEST WALL

CASE RECORDS

CASE I.—E. M., four and one-half years; American. Admitted January 14, 1914, Ward 1. History: One year breast fed. At two and one-half years—treated O. P. D. P. H. three months for “trouble with leg” (no further record). Able to walk at three years, ten months—Manhattan E. and E., sore over left eye two weeks ago, lump on chest, painless, gradual increase in size. No cough, fever, loss of weight or appetite loss. Patient doesn't look sick. Left axillary glands slightly enlarged. Corneal opacity, small, right and left. Carious teeth. Left thigh 1 cm. smaller than right. Motion O. K. Tonsils O. K. Lungs clear. Spleen negative. Liver 2 cm. below costal margin. Wassermann negative. Von Pirquet positive.

Surgical condition: Third space left of sternum—3 cm. smooth hemispherical swelling, red, thin skin, fluctuating felt movable on deep pts.

Operation June 20, 1914: Doctor Jameson—two-inch incision, two cavities three-quarters inch in diameter. Sinus from each into mediastinum through intercostal space, thick yellow pus. (No excision.) Probed, swabbed with tincture of iodine. Silkworm gut closure tight. Pathological report—tuberculosis.

Discharged January 30th to country—wound unhealed on account of small stitch abscesses.

Follow-up October 25, 1921: Six and one-half years after operation. Wound closed three weeks after discharge and remained healed. Boy looks and acts well, but not very robust. There are enlarged nodes in both axillæ and both sides of the neck, those on the left side being about twice the size of those on the right.

Comment: A successful result. It seems scarcely possible that this case could have had a tuberculous bone focus, yet there was a cavity behind the intercostal muscles.

CASE II.—T. M., sixteen years, United States. June 24, 1915. History: Five months lump to left of sternum; first noticed it on throwing a ball. Slightly tender and reddened for a week—never persistently painful. Aspiration two weeks ago—pus obtained, recurred in three to four days. One year ago glands removed from the left side of neck. Six years ago double inguinal hernia operation. No cough; night-sweats; history of tuberculosis in family or associates. Physical examination—pyorrhea and caries. Scar in neck. Slight enlargement cervical nodes—axillæ free. On anterior chest, third to fifth rib left side, soft fluctuating swelling which is not tender. Skin reddened and thin toward median line. Sputum and urine negative for tuberculosis.

Operation June 26, 1915: Abscess over sternum at level of second, third and fourth costal cartilages and beneath pectoralis major to its margin near axilla containing greenish-white pus with floccules in it. Wall—bluish granulation tissue. Beneath intercostals in second space was a small pocket that could not be seen communicating with any manifestly inflamed bone.

Elipse of thin skin removed; cavity entered after much of the abscess had been dissected away. Small amount iodoform sprinkled into deep pocket between ribs. Muscle sutured and skin sutured with few twisted silkworm gut strands at lower angle. Pressure dressing.

Pathological report: Tuberculosis. Smears—no tubercle bacilli found. Guinea-pig injection—pig developed tuberculosis.

Discharged on sixth day. Wound healed without inflammation; slight discharge from drainage tract.

Follow-up, July 25, 1915: Gained five pounds. Tiny drainage spot granulating, now flush with skin.

October 25, 1921: Six years, four months. Has enlisted in army; sixth year is up April, 1922. Is now a corporal of Mounted Police Guard, Fort Sam Houston,

Texas. Weight 144 pounds. On football team; is sharp shooter. Also won blue ribbon in horse race. After coming home never was ill. No cough.

Comment: Successful result. No evidence of bone focus. Cavity behind the intercostal muscles.

CASE III.—E. F., fifty-six years, cigarmaker, Cuba; in United States twenty years.

Always a heavy smoker, a cigarmaker by trade, and generally in good health up to five years ago, when he was in the French Hospital for a week with fever, cough and pain in his chest. "One-half a gallon" of fluid was taken from his left chest, and he was told he had pleurisy.

He felt quite well after this, maintained his weight, had no cough, sweats, hæmoptysis nor other symptoms indicative of tuberculosis until one month before entering the Presbyterian Hospital in May, 1918. He then noticed a lump "the size of an egg" in the lower part of his chest in the anterior axillary line at the level of the seventh rib. It didn't seem to grow but was slightly tender and gave him dull, aching pain. At the left apex were a few subcrepitant râles and dulness with diminished breath sounds. At the left base were occasional râles, dulness and diminished breath sounds. The swelling over his seventh rib anteriorly was soft and fluctuating. The skin over it was of normal color. Pus mixed with blood was obtained on aspiration and tubercle bacilli subsequently obtained from the lesions in the inoculated guinea-pig. Sputum which was very scant showed no tubercle bacilli. A tuberculosis fixation test, it is interesting to note, was negative.

X-ray showed increase in density at the left base "suggesting fluid, and increase in density at the left apex and accentuation in the linear markings in the right upper lobe" suggesting tuberculosis.

On June 12, 1918, he was operated on for the abscess. A cavity lined with bluish red granulations and containing about 100 c.c. of necrotic tissue and grumous fluid was dissected out. No evidence of rib involvement could be made out, and it appeared that the abscess lay almost entirely superficial to the intercostal muscles. About three inches of the sixth and seventh ribs were removed, together with the intercostal muscles. The underlying tissues seemed healthful and the skin was closed without drainage. A compression dressing was used to obliterate the dead space.

Pathological report showed "tuberculous granulation tissue." Through a misunderstanding the wound was dressed on the seventh day. The intention was to maintain a snug pressure for twelve to fourteen days. The wound was reported clean and apparently healed. He was discharged to the Out-patient Department. Within a few days a little fluid reaccumulated. A small hole was made and some thick, bloody fluid evacuated on the thirteenth day, and pressure reapplied with each dressing.

On the thirty-first day the wound was healed and stayed closed until five and one-half months after the operation. Two tiny sinuses, discharging almost nothing, then appeared, and scabbed across and reopened for ten months. I then referred the case to Doctor Hanford, who was then concentrating his attention on the treatment of tuberculous lymph-glands and chronic tuberculous sinuses. Following a course of X-ray treatment, the sinuses closed for a few months but reopened nineteen months after operation. Twenty-one months after operation he was readmitted to the hospital under Doctor Hanford's care.

March 16, 1920, the sinuses were explored, curetted and packed with five per cent. iodoform glycerin emulsion and further radiotherapy was instituted, and he was again discharged from the hospital. Twenty-three days later, following a considerable increase in the amount of discharge for a few days, it was found that a probe be passed into a larger cavity, presumably into his pleural cavity.

TUBERCULOUS ABSCESSES OF THE CHEST WALL

SUMMARY

	1. E. M.	2. T. M.	3. E. F.	4. A. N.	5. S. W.	6. G. P. K.	7. W. L. C.	8. F. M.	9. D. M.
Age	4 1/2	16	56	19	30	23	53	37	62
Nationality ...	U. S.	U. S.	Cuba	U. S.	W. Indies	U. S.	China	Italy	U. S.
Duration of abscess	2 wks.	5 mos.	1 month	2 wks.	5 mos.	8 mos.	No record	3 mos.	3 mos.
Associated and etiological factors	Axillary lymph glands	Cervical lymph glands	Fluid in chest 5 years previously	Hæmolytic streptococcus pneumonia and Empyema, Pul. Tb.	Tbc. elbow vertebra psoas abscess. Peritonitis	Influenza year previously	Addison's disease, pneumonia(?) six mos. previously	Addison's disease influenza	Pulmonary Tbc. syphilis
Side of lesion	Left	Left	Left	Left	Left	Left	Right	Right	Left
Lesion	Two small abscesses perforating 3rd space close to sternum	Large subpectoral abscess perforating 2nd space near sternum	Abscess anterior axillary line 7th rib tuberculous empyema	Ant. axillary line eighth, 5th, pulsating Empyema Necrotic	Large subpectoral abscess perforating 2nd & 3rd near axilla	Large subpectoral abscess perforating 3rd and 4th, close to sternum. Tbc. axillary nodes	Large calcified mass fourth to seventh ribs posteriorly	Subpectoral abscess perforating third, 4th, 5th, to mass of calcified matter extending from third-seventh ribs in pleura	Abscess in ant. axillary line & fifth & 6th. X-ray shows calcified pleura
Operations	Incision Iodine closed tight Secondary union	Partial excision to do form closed except superficial skin drain	Excision of abscess & pieces of two ribs. Multiple rib excision	Nine aspirations. Thoracotomy with partial rib excision. Multiple rib excision. Abscess excised in multiple rib resection	Excision abscess, no drain. Exploratory lap. Resection elbow evacuation psoas abscess with closure. Drainage of psoas abscess	Excision abscess & piece of second costal cartilage super-ficial skin drain	None	Excision of abscess & piece of fourth rib —no drain	Excision of abscess & pieces of fourth & fifth ribs
Results abscess	Permanently closed after thirty days	Permanently closed in about three wks.	Closed after thirty-one days —remained so for 5 1/2 mos. Small sinuses for 15 mos. occasionally closing	Practically merged in the empyema cavity	Primary union permanently closed. Fluctuation re-appeared after 7 months	Permanently closed after two weeks		Primary union, permanently closed	Recently operated on
Patient	Well	Well and in U. S. Army	In a Tb. hosp. with considerable chest wall defect. Slowly improving	Large chest defect but working and in surprisingly good condition	Died nine months after abscess excision	Well	Died	Well & working. Apparently an improved case of Addison's disease	

April 16, 1920, seventh and sixth ribs were removed for about 12 cm., with chest wall between.

August 2, 1920, posterior portion of seventh and sixth together with part of the fifth and fourth ribs were removed.

December 9, 1920, anterior portion of fifth and sixth ribs removed.

February 8, 1921, removal of eighth rib.

April 6, 1921, removal of posterior portion of seventh rib.

May 10, 1921, removal of anterior portion of fifth, sixth and seventh ribs.

For the past year and a half the story has been one of repeated attempts to excise tuberculous sinuses and remove tuberculous bone. He is now in a tuberculosis hospital. His condition is fair and slowly improving.

Comment: A case whose course might have been far better had he, after the first operation, had a thorough and prolonged course of anti-tuberculous treatment. This abscess did not involve bone at first and occupied the intercostal space mostly outside the muscle. An unsuccessful surgical result though not a complete failure.

CASE IV.—A. N., female, nineteen years, single, United States. Cigarette packer.

Admitted to Rockefeller Institute Hospital, August 29, 1918. Had worked as a cigarette packer four years. Best weight, three months ago, 107, and has lost eleven pounds. Cough for two months.

Six days before admission had severe pain in left chest with fever, prostration but no increase in the cough she had had for two months. She had a right upper and left lower pneumonia and many tubercle bacilli were found in sputum.

She remained in the Rockefeller Hospital a little over two months, and was then referred to Otisville Tuberculosis Hospital, but refused to go. During this time, her right side cleared up, but fluid appeared on the left side that grew out hæmolytic streptococcus. She was aspirated six times: September 9, 1918, 20 c.c. yellow, cloudy fluid; September 25, 1918, 125 c.c. turbid, yellow fluid; September 27, 1918, 5 c.c. turbid, yellow fluid; September 28, 1918, 5 c.c. turbid, yellow fluid; October 5, 1918, 900 c.c. turbid, yellow fluid, one-eighth pus; October 25, 1918, 450 c.c. thicker yellow purulent fluid, one-quarter pus.

For two and one-half months she remained home, felt weak, had dyspnoea on exertion but no cough and very little fever, if any.

On January 19, 1919, she walked into the Presbyterian Hospital (Fig. 1), having noticed for two weeks a soft fluctuating swelling on left side in anterior axillary line at level of eighth and ninth ribs, that was sore. Leucocytes 12,000, polymorphonuclears 90. Slightly dyspnoeic on exertion, pulse ranging from 80 to 100, temperature 99° and respirations 20 to 24. The swelling on her side pulsated with the heart beats. The remarkable feature was the disproportion between the signs in her chest and her general appearance. The whole left side was flat, with lost fremitus and breath sounds gone. The heart pulsated to the right of the sternum, and was greatly displaced. Eighteen hundred c.c. of white creamy pus was removed by aspiration and hæmolytic streptococci and large numbers of tubercle bacilli found. She became more comfortable but began running a temperature. Seven days later 410 c.c. more fluid of the same sort was aspirated, and six days after that 1500 c.c. more. With each aspiration the abscess in the chest wall diminished in size. Her sputum, scant in amount, contained tubercle bacilli. Her temperature ran an irregularly septic course occasionally to 104°.

A serious problem was accordingly presented, namely a young woman with an enormous hæmolytic streptococcus empyema that had lasted about five months, had been aspirated repeatedly, had almost perforated spontaneously, and was associated with tuberculosis of the lungs and pleura and chest wall.



FIG. 1.—Case IV. A. N. Tuberculous abscess of chest wall due to a mixed hæmolytic streptococcus and tuberculous empyema, an "empyema necessitatis." The cavity contained over 1800 c.c. of pus. This is really a "collar button" type of abscess where the deep collection is enormous. That this chest wall abscess had its origin from the collection in the pleura is scarcely to be doubted. That other more localized pleural or mediastinal tuberculous foci may give rise similarly to the superficial abscesses seems equally reasonable.

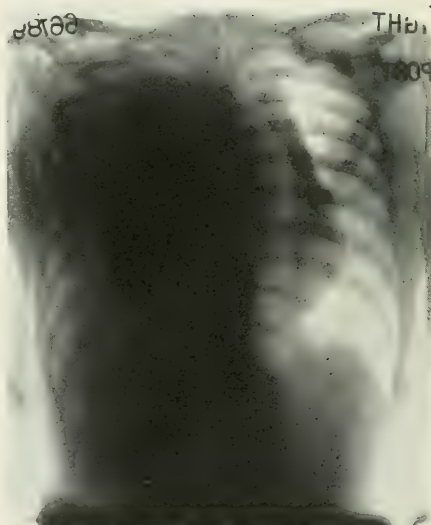


FIG. 2.—Case IV. Plate 1. Abscess with empyema necessitatis. X-ray on admission showing enormous fluid collection on left side with great heart displacement to the right. The abscess on the chest wall doesn't show. Hæmolytic streptococci and innumerable tubercle bacilli were found in the pus.



FIG. 3.—Case IV. Plate 2. Abscess with empyema necessitatis. X-ray taken the day after admission. Eighteen hundred c.c. of pus had been removed by aspiration.

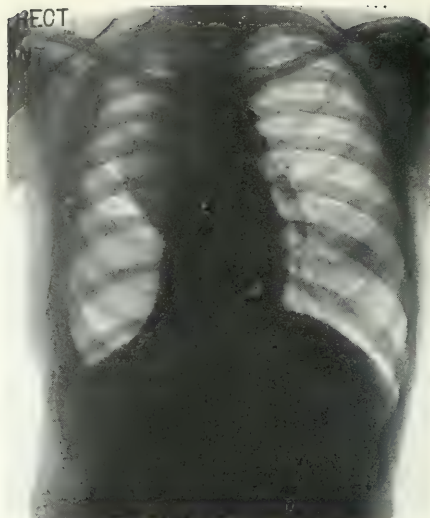


FIG. 4.—Case IV. Plate 3. Abscess with empyema necessitatis. Plate taken three weeks after drainage by excision of a piece of ninth rib. In spite of suction, use of Dakin solution, etc., there is no evidence of lung expansion. The large, tubercular pyopneumothorax with the contracted tuberculous lung is shown. The appearance was just the same two and one-half months after operation.



FIG. 5.—Case IV. Plate 4. Abscess with empyema necessitatis. One month after removal of five ribs showing wide open pneumothorax with Carrel silver wired tubes (displaced from their position near the apex) in the cavity.



FIG. 6.—Case IV. Plate 5. Case of abscess with empyema necessitatis. Plate taken thirteen weeks after multiple rib resection. There is some reduction in the cavity. Four more ribs require removal, but the patient refuses to have the operation as yet.

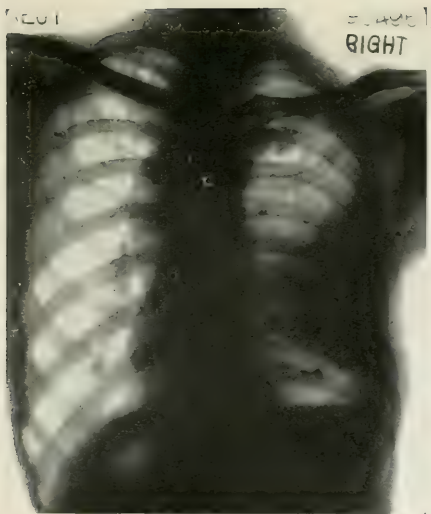


FIG. 7.—Case VII. The Chinaman who died of Addison's disease. On the right side is shown the shadow cast by the calcification and ossification of his pleural and intercostal spaces. Cf. Cases VIII and IX.

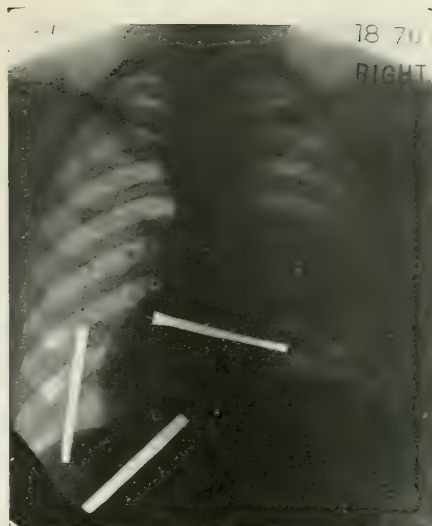


FIG. 8.—Case VIII. Plate 1. In this case many flattened calcium fragments were found and some removed. (Plate broken and repaired.) He had the symptoms of Addison's disease and improved. The calcium deposits are seen on the right side. Cf. Cases VII and IX. Taken March 27, 1920. Before operation.

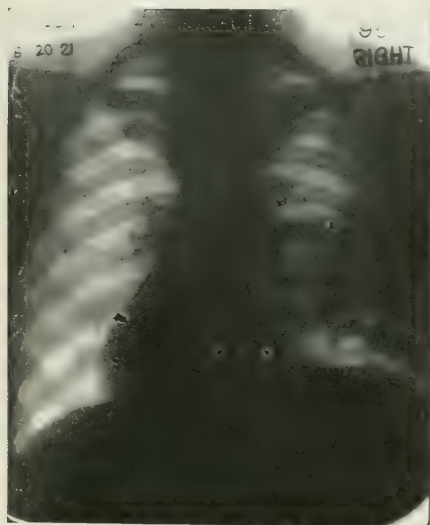


FIG. 9.—Case VIII. Plate 2. Taken September 20, 1921. Operation, April 8, 1920. Shows dense calcium shadows, but less diffuse cloudiness almost 1½ years later.



FIG. 10.—Case IX. The shadow cast by the sheet of calcium in the pleural space in the left side is clearly shown. Cf. Cases VII and VIII.

TUBERCULOUS ABSCESES OF THE CHEST WALL

Such was the story of the tuberculous abscess of the chest wall. Its subsequent course devolved into the problem of a non-expanded tuberculous lung, even the advisability of expanding it being questionable, and a tuberculous empyema cavity. Suffice it to say that very marked general improvement followed removal of a piece of the ninth rib with drainage on February 7, 1919. Removal of most of the tenth, ninth, eighth and seventh and sixth ribs on April 24, 1919, was followed by a long period of sepsis, which, however, she finally overcame, leaving the hospital on the 294th day after admission, having regained her former weight and looking in extremely good health with a large, steadily contracting opening in her left chest wall.

She is shown as one of the cases at the meeting of the New York Surgical Society, working and in fair health, but with a sinus of considerable size that extends to the apex of her pleural cavity.

Comment: A type of tuberculous chest wall abscess, namely an empyema necessitatis, the pathogenesis of which perhaps bears a closer relation to the other cases than is generally supposed.

CASE V.—S. W., male, thirty years, negro, born in West Indies.

Came to the United States ten years ago. Had always been well and working as a Pullman porter up to his twenty-eighth year, when he was sick in bed for nine weeks with "typhoid." Ever since he has had a cough and pain in elbows, especially his left. About two years before entering the hospital, he was studied in the Out-patient Department and found to have chronic pulmonary tuberculosis without bacilli in sputum but with signs of fluid in his right chest. He refused to enter the hospital at that time and visited doctors outside, and Hospital for the Ruptured and Crippled, Roosevelt and New York Orthopædic Hospital. Finally he returned and was admitted, with circumscribed, elastic and fluctuating, painless swelling beneath his left pectoralis major muscle, present for five months, swollen and stiffened left elbow for three years, swollen abdomen containing fluid and hard masses in either iliac fossæ and felt on either side of rectum, noticed for about four months, swelling and marked œdema of left leg for five months.

To condense a long and drawn-out story, he had a tuberculous abscess of chest wall in region of left second, third and fourth ribs, extending through the second interspace to a cleft between the lung and chest wall, behind the second rib, tuberculous peritonitis, with moderate amount of fluid and innumerable adhesions binding together and immobilizing distended coils of small intestine, right and left psoas abscesses, the left enormous, and before his death, about ten months later, found to contain over 1300 c.c. of pus, tuberculosis of his fifth lumbar vertebra, tuberculosis of his left elbow-joint.

In spite of it all, his general condition seemed surprisingly good though his lesions progressively increased in evidence. In retrospect, the results of the surgical attempts on his so-called surgical conditions are most interesting and instructive. They were characterized by temporary success and ultimate failure.

All of his lesions were proven tuberculosis by guinea-pig injection and actual finding of the tubercle bacilli.

June 15, 1918: The chest wall abscess was excised and its deep communication curetted out. A little iodoform left in. The wound was closed tight, dressed the fourteenth day and healed by primary union. Fluctuation reappeared in January, 1919, seven months later, but the wound never opened up to his death, nine months later.

At the same time his abdomen was opened, fluid evacuated and peritoneum washed with saline. The wound healed primarily.

He was discharged on the twenty-sixth day after his operation, July 11, 1918, to the country.

Two months later he returned to the Follow-up Clinic with his chest wound well healed and his abdomen much smaller.

Because of his improvement and because his left elbow was swollen and stiff and useless and gave him pain if he attempted to use it, he was readmitted and on August 21, 1918, elbow-joint was resected through a bayonet incision. Wound healed primarily and remained healed for three months when a small sinus appeared. It never closed.

He had been allowed to use it and had regained, at one time, about 30° flexion and extension and slight pronation and supination. It would have been better to have kept it immobilized for ankylosis.

December 11, 1918, an enormous left psoas abscess evacuated through an incision near anterior superior spine. Wall sponged off, iodoform emulsion distributed and wound closed tight in layers. Primary union. This wound remained healed until February 19, 1919, when it was reopened and over 1300 c.c. of pus evacuated.

By this time it was evident that he was so overwhelmed by tubercle bacilli that further operating should be for symptoms giving him pain. He was having diarrhoea and obstruction symptoms. The psoas abscess was accordingly opened and allowed to drain. Whereas he had been running an irregularly septic temperature, this dropped to a normal range with subnormal excursions and he died two months later on April 20, 1919.

Comment: The chest wall abscess showed no rib involvement that could be found. It never reopened after excision with curettage of the deeper pocket beneath the intercostal muscles, though fluctuation returned over half a year later, in spite of the fact that the patient was practically riddled with tuberculosis. The elbow resection was probably poor judgment to attempt at the time it was done. Continuation of his anti-tuberculous régime at that particular time would have been better.

CASE VI.—G. K., female, twenty-three years, United States.

At six years tonsils and adenoids removed. At fourteen years measles. At eighteen years began work as stenographer. At twenty-one years influenza. Sick two weeks. Weight 110 with clothes on. At twenty-one operation for adhesion about cæcum and chronic appendicitis. At twenty-second year, September, 1919, first noticed a six-cm. lump upper inner quadrant of left breast.

Soon afterwards felt a painful lump in left axilla. Was advised that she had a tumor in her breast that would require breast removal. For the past year not as vigorous as usual.

April 27, 1920: First examined by writer. She was then twenty-three years old; temperature 99.8°. Slender young woman, weighing 101 and evidently under weight. Lungs clear, no râles; cogwheel breathing left base posteriorly and at sides. A negative physical examination otherwise, except for a diffuse fluctuating swelling about 15 cm. across in region of the second and third left costal cartilages; slightly movable on chest wall with pectoralis major slack, but quite fixed when contracted. It was evidently beneath the breast and pectoral muscles. A rather large mass, over 4 cm., was readily felt in the left axilla. X-ray report by Dr. A. H. Busby "shows no definite evidence of pathology in the bone substance of the anterior upper left ribs, but there is a small peculiar shadow showing abnormal density over the situation of the cartilage in the anterior portion of the upper left second rib, which makes me suspicious of some pathology in the cartilage at this point. Whether the process is actually in the cartilage or due to a soft tissue opacity in the upper portion of the left breast it is impossible to differentiate, yet I am suspicious that it is cartilage at fault. The heart and vessels are negative. There is some peribronchial thickening which is slightly more extensive in the left lung, numerous enlarged glands are visible about the

TUBERCULOUS ABSCESES OF THE CHEST WALL

roots of the lungs and a few calcified nodes are seen. Both apices show a slight infiltration, more in the right than the left, which is suspicious of a tuberculous infection. It is of course very slight in extent, yet the right apex suggests activity."

Operation, May 11, 1920: Pathology—The axillary mass consisted of caseating tuberculous lymphnodes. The main abscess cavity was beneath the pectoral muscles. The cavity was about 12 cm. in diameter. It was lined by thick bluish-red tuberculous granulations, and contained much turbid fluid with flakes and masses of coagulation necrosis matter in it. Between the 2nd and 3rd costal cartilages ran a small sinus to a deep pocket between lung and thoracic wall, running upwards behind the cartilage of the 2nd rib containing about an ounce of thick, coagulation necrosis material.

The costal cartilage was a little uneven but no rib necrosis nor evidence that rib or costal cartilage were primary foci could be determined.

Procedure: An inframammary incision carried toward axilla was done. Axillary nodes removed. Breast reflected upward on neck and pectoralis major split longitudinally and as much of abscess enucleated as possible before breaking into it. Sinus carefully curetted, a little iodoform powder dusted into it, muscle closed by suture and skin closed with two little rubber tubes just through skin at either end of incision. A snug pressure bandage applied to as far as possible obliterate dead space.

Pathological Report—by Dr. A. P. Stout. Tuberculosis of abscess wall and axillary nodes. The cartilage, "on cut section it shows no gross abnormality." "The costal cartilage showed a very marked irregularity in the staining process and there is irregularity in the arrangement of the cells."

Culture of fluid from abscess—"sterile." M. Mueller. Guinea-pig injection. "Smears show presence of tubercle bacilli." R. H. Pauli, May 12, 1920. Autopsy, June 24, 1920. "Tubercles in spleen, liver and lungs." "Microscopic positive for tuberculosis." W. C. Von Glahn.

Sutures and drains out on sixth day, discharged on thirteenth day. Scabs over drainage tract. In good condition and afebrile. Weight 99 pounds.

Follow-up note: Four months, September 7. Weight 107¾ pounds, more than she had ever weighed in her life. Taking cod-liver oil and is sunburned. Feels well. Scar healed and has never broken down. No evidence of recurrence of lump. Six and one-half months, November 22nd. Weight 112½ pounds. Feels very well indeed. November 23rd, examined by Dr. A. R. Lamb. Temperature, 98.6°; pulse, 100 (excited); blood-pressure, 135-90. No tuberculosis symptoms; at top weight and better than ever before in her life. Chest—good expansion, including apices and bases. Absolutely normal all over except slight catchy respiration over left lower lobe. Returned to work.

One year—May 3, 1921. Weight, 107¾ pounds; temperature, 99.2°; pulse, 90; respirations, 18; blood-pressure, 115. Lungs clear. Wound O. K. No recurrence of swelling. Somewhat tired after winter's work, but feels quite well otherwise. July 15, well 103 pounds. October 26, 1921, one year five months. Presented at New York Surgical Society meeting. Feels quite well; 112 pounds. No recurrence of abscess.

Comment: No rib lesion demonstrable. Abscess communicated with a cavity beneath the intercostal muscles. A case treated under favorable anti-tuberculosis conditions.

CASE VII.—W. L. C., male, fifty-three, cook, Chinaman—S., four years in United States. No history of previous respiratory trouble, but was sick in bed with fever in California several years ago. Loss of twenty-nine pounds in six months. Six months ago caught cold, chills, and four or five days fever. Ached in shoulders and hips. Soon noticed dyspnoea on exertion; weakness, and had to stop work;

darkening of lips and gums for four months; darkening of skin, gradual and progressive; sore mouth; anorexia and slight abdominal pain; night-sweats a few months ago; nocturia three to four; emaciation. Skin dark brown with darker blotches, more on body and arms than on legs. Tongue and gums show irregular patches of blue black color. Slight dorsal scoliosis to left. Left chest larger than right and showed compensatory emphysema. Right chest immobile, dullness, fremitus absent, diminished breathing, diminished voice. No râles. Blood-pressure 86-56. Arteries soft. Right upper quadrant tender and resistant. Blood count, 5,000,000; white blood-cells, 9600; polymorphonuclears, 58; hæmoglobin, 75 per cent. Wassermann negative. X-ray, September 29, 1921. Definite dense shadow in lower part of right lung. Blood urea, 0.9 grams per l. Creatinin, 1.5 mg. per 100 c.c. Gastric—free HCl, 30; total acidity, 54; guaiac negative. No fever on admission.

Died rather suddenly early one morning four days after entering hospital, after a chill and elevation of temperature to 103.4°.

Clinical Diagnosis: Addison's disease. Calcification of pleura.

Comments: Though this case had no actual abscess, his chest wall was so similar in other respects to Cases VIII and IX that he is included in this series.

AUTOPSY REPORT ON CHEST WALL

"Chest Wall.—On the right side, beginning with the fourth rib and extending down to the tenth rib, there is extreme thickening of the chest wall, with calcification of the intercostal muscles. The thickness of the chest wall through this region is perhaps 3 to 4 cm. Near the vertebral column, over the sixth, seventh, eighth and ninth ribs, there is a depressed crater, about 3 cm. in circumference. This probably represents an old encapsulated abscess. The tissue about this crater is densely calcified; the floor covered by a continuation of the smooth, opaque, thickened pleura.

"The right lateral chest wall of the thorax from the fourth to the tenth ribs was removed. After fixation, a vertical saw cut was made and the following condition noted: The ribs themselves contain a normal red marrow throughout their whole length and are not abnormal. The thickening of the thoracic wall is found to be due to a bony plate, consisting of an inner and outer table, separated by red and yellow marrow. The outer table is about 3 mm. in thickness, the inner one a little thinner. This bony plate is covered on the pleural surface by a glistening, white, opaque, fibrous membrane, to which shreds of lung tissue are still adherent. The lesion is thus confined to the pleura itself."

Beyond a small superficial scar at the left apex the lungs were rather strikingly free from the lesions of tuberculosis.

Most of both adrenals were replaced by tubercle tissue. The lymphnodes about the pancreas showed tuberculosis.

CASE VIII.—F. M., male, aged thirty-seven, Italian; railroad laborer. Measles in childhood and "malaria" at fifteen. Came to United States from Italy when eighteen. Married at twenty-one; wife is well and has had eight pregnancies, but three children died. She had no miscarriages. Remaining children well. Worked as laborer drilling rock up to ten years ago. Since then a track laborer on railroad. At thirty-six years, in 1919, one year before admission, weighed 149 pounds, which was as much as he had ever weighed in his life.

In May, 1919, ten months before admission, was in bed fifteen days with "influenza." He had an eight-day cough with sputum that was not bloody nor yellow. Was "laid up" for one month. From this time on he has not been well. He returned to work throughout the summer and fall for six months. He dates the appearance and increase of pigmentation of his face and other portions

TUBERCULOUS ABSCESES OF THE CHEST WALL

of his body from this time. For three months he has noted a lump appear and grow to its present size just above and inside his right nipple region. Finally, a month ago, pain began after lifting heavy weight that he had been accustomed to frequently lift before. Two weeks ago this became severe enough to stop his working. The right shoulder and back of his neck gave him most trouble, especially at night and on moving his arm.

His weight is 117, a loss of thirty-two pounds in a year. He is steadily growing weaker and complains of gas eructations following meals.

Physical Examination: The most conspicuous thing in his general appearance was the pigmentation of his face, flexor surfaces of his arms, shoulders, waist line and where pressure points exist. One very small pigmented spot was noted on the buccal mucous membrane of cheek.

A few discrete enlarged nodes in right axilla, fewer in neck and one in left axilla.

On anterior surface of right chest with fourth rib as a centre just outside the costochondral junction and over the third and fourth interspaces, a soft fluctuant swelling about 10 cm. in diameter. It was beneath the pectoral muscle and but slightly tender. Expansion of right chest is diminished. There is almost flatness and much diminished breath and voice sounds at right base anteriorly and laterally. Fremitus is lessened.

His heart was negative, his arteries soft and his blood-pressure low. Weight 117.

Blood-pressure: March 24th 94/78, March 29th 88/70, March 30th 82/70, March 31st 82/70, April 1st 86/70, April 2nd 90/68, April 3rd 94/72, April 6th 88/66, April 8th operation, May 7th 80/60, May 15th 78/40, May 16th discharged.

Blood-pressure (follow-up): June 7th 90/50, weight 132; September 1st, weight 125; September 3rd, 75/50, weight 128½; December 13th, weight 149½; December 20th 115/75, weight 150; (1921) January 17th, weight 148; January 31st, weight 151¾, June 27th 115/80, weight 144; July 12th 90/65, weight 143; September 20th 110/78, weight 145½.

Blood chemistry, basal metabolism, phthalein and gastric test meals were all normal in range. The red blood-cells, 6,000,000; hæmoglobin, 80 per cent.; leucocytes, 8000, and polymorphonuclears 70 per cent. Von Pirquet was positive. Wassermann negative.

X-ray showed "large quantity of calcified material in the right side of the chest, which extends from the third to the seventh rib anteriorly and seems to be due to calcification of the pleura."

A week before operation following the slight exertion incidental to metabolism test, patient became prostrated and complained of pain in back of neck and abdominal cramps. It looked as though at that time he might die.

Early the next morning he had severer pain in his back and vomiting. During the stay in the hospital, and even after discharge, for several months various observers commented on the increase in the density of the pigmentation.

For some reason or other a more than usual interest was taken by the various members of the interne and attending staffs in the diagnosis.

Because of the asthenia, pigmentation, low blood-pressure, gastro-intestinal symptoms and the lesion in his chest, when it was found to be tuberculous, the consensus of the whole staff was that he presented the symptoms of Addison's disease and his prognosis altogether bad.

At various times during the study of the case the chest wall lump was considered empyema necessitatis, gumma, tuberculous abscess, lung tumor, hypernephroma metastasis, simple abscess of rib, and it was rather interesting that so many views should have been advanced.

Aspiration was done and 10 c.c. of greenish-yellow fluid sterile in aërobic and anaërobic media was obtained. It contained 75 per cent. polymorphonuclear cells. Tubercle bacilli were subsequently recovered at the autopsy of inoculated guinea-pig.

Operation April 8, 1920: One per cent. novocaine; last part, gas and oxygen.

Pathology: Beneath pectoralis major lay an abscess full of about 60 c.c. of greenish, creamy pus with flakes of necrotic granulations throughout. Wall was sharply circumscribed. In third interspace, running downward and outward to pleural space behind the fourth rib and fourth interspace, and even behind the fifth rib, was a crevice or slit, lenticular in shape, full of fragments and plaques of calcium salts. Some of these were loose and readily removed, others not.

Pectoralis major split, abscess wall dissected out. Portion of fourth rib excised. Many fragments and plaques of calcium removed and cavity smeared thinly with a little iodoform suspended in oil. Pectoralis minor muscle origin from rib cut away and muscle packed into sinus. Pectoralis major sutured and skin closed tight with no drain whatever. Pressure dressing applied.

Forty-eight hours postoperative; temperature to 106.4° ; and iodine was found in urine. Within two days temperature came to normal and remained there.

Wound dressed sixth day because it was getting a little loose. Stitches removed. No sinus. Wound healed by primary union and never opened. Transferred to medical wards on eighteenth day, where he was given a high caloric diet.

Discharged thirty-eight day, postoperative.

He has been seen twelve times in follow-up clinic and is now a wholly different picture.

He has gained twenty-five to thirty pounds in weight.

Pigmentation has disappeared.

Strength is fast returning, and the wound has remained healed with no recurrence of abscess though his calcium plaques are still present. At his base is dulness, diminished breathing and a few râles.

His blood-pressure has returned to a low normal. (See blood-pressure table above.)

Comment: He is considered by all who have seen him as an improved case of Addison's disease; from this standpoint alone, a case worthy of note and careful following. No rib involvement was found. It seems likely that he had a flare up and possibly pleural exudate at the time he had "influenza," but it is hard to believe so much calcium could have been formed in so short a time—ten months. It seemed likely that he had tuberculosis in his lung or pleura or in his mediastinal lymphatics much longer. Case shown before the New York Surgical Society, October 6, 1921.

CASE IX.—D. M., male, sixty-two, carpenter, United States.

At twenty-five, thirty-seven years ago, Neisser infection. No history of lues. At thirty-three, twenty-nine years ago, pneumonia, but a certificate made out by his doctor for insurance benefit was signed "phthisis." It took him "one year to cure this" by an out-of-door life and creosote internally and by inhalation. At fifty-eight, in 1918, he had influenza with a bad cough for three months. Went to work at Long Beach and in three weeks his cough stopped. Six months ago had a temporary recurrence of cough. Three months ago soreness developed in his left side and two months ago found a small lump over region of fifth rib in anterior axillary line.

A thin, wiry man of 124 pounds, who looks as though he had lost weight. There are subcrepitant râles at both apices and in first interspace on left side. There are occasional râles at both bases. Breath sounds, voice, fremitus and resonance are not very markedly changed. In the anterior axillary line over the

TUBERCULOUS ABSCESSES OF THE CHEST WALL

fifth rib is a fluctuating, slightly tender swelling not attached to skin, not pulsating, and fixed on chest wall.

X-ray shows an irregular mottled area of shadow suggestive of calcification of pleura. Red blood-cells, 4,200,000; hæmoglobin, 80 per cent.; leucocytes, 8200; polymorphonuclears, 75 per cent. Blood urea, uric acid and sugar are normal. Urine is quite negative. Blood—Wassermann: Chol. four plus; alc. four plus.

Aspiration of abscess: Grayish, caseous-appearing material containing much cellular débris. No organisms seen.

Case shown before operation at the New York Surgical Society, October 26, 1921.

Subsequent Note: Operation, October 29, 1921. Local anæsthesia. Abscess excised and about 12 cm. of fourth and fifth ribs removed with intercostal muscles. The upper margin of the fifth rib was slightly concave, as though there had been some decalcification, but this seemed a small lesion compared to that on either side of it. The pleura had been changed to a firm sheet of smooth, calcified, possibly ossified material that could be tapped on with an instrument, producing a resonant tympanitic sound, due to the subjacent lung. A sinus from the abscess cavity only about 0.5 cm. in diameter led to the surface of this sheet of calcium at the level of the fifth rib and was attached to a very small punctate depression that would not admit the end of a probe.

The wound was closed after smearing in a small amount of iodoform and splitting the pectoralis major so as to draw it across the sheet of calcium, suturing it to the serratus magnus.

Tubercle bacilli were found in the pus from the abscess. Twelve days later he was doing well.

OBSERVATIONS ON A CASE OF POST-OPERATIVE TETANY WITH IMPLANTATION OF HUMAN PARATHYROIDS

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IN the ANNALS OF SURGERY for February, 1911, Dr. W. H. Brown of Colac published the details of a very striking case of cure of post-operative tetany by transplantation of human parathyroids. The case I report now was also originally under his care and was treated by me in conjunction with him.

The patient, a woman aged thirty had had the right lobe of the thyroid removed eight years ago, in a neighboring city. While in bed recovering from the operation she had an attack of cramps, which had ever since recurred with great frequency. The longest interval between them might be two to three months, but they were decidedly most severe at about the onset of the menstrual periods. Eighteen months before she had become pregnant and had been entirely free from attacks throughout pregnancy: After her confinement, however, they recurred with greater frequency and severity and rendered her unable to do her usual housework. She was a stout woman and her general mental state was one of intense neurosis. She was absorbed in herself and her illness and described "queer feelings" to an unlimited extent. Her attacks consisted of cramps in the limbs and body with severe pains round the heart. The hands assumed the typical tetany or "obstetric" position. The elbows were strongly semi-flexed, the ankles plantar-flexed and the toes pointed. Her pulse in the attacks was from 100-110 and she was afflicted with severe terror. Chvostek's facial nerve sign was present.

She was in this condition when first seen on August 21, 1919. She was given thyroid sicc: gr. ii with calcium glycerophosphate gr. xx daily. A month later she reported that she had a good deal of stiffness with profuse sweating. The calcium dose was increased up to thirty grains thrice daily. Larger doses than this made her sick and were refused. Her attacks were relieved to a large extent by one drachm doses of syrup of chloral.

On December 8th a woman of fifty died in the hospital of exophthalmic goiter and three parathyroids were obtained from her body and implanted within an hour, under the aponeurosis of the external oblique muscle. Some difficulty was experienced in freeing the graft bed from fat. The wound in the succeeding days showed signs of breaking down but no actual suppuration occurred. There was no improvement, even temporarily, from this operation. For the next four months her attacks were frequent and severe, one every forty-eight hours or less. Her mental state was extremely neurotic, and her pulse varied from 80 to 100. Her condition in April, 1920, was worse generally, both cramps and neurotic symptoms being very marked. Her temperature during the month rose gradually to a maximum of 101° Fahrenheit, and fell as gradually to normal. No intercurrent disease could be discovered.

On April 16th one bullock's parathyroid was obtained from the abattoir, and injected emulsified in glycerin intramuscularly. No obvious effect was produced. Her condition got generally worse until May 25th when four more bullock's parathyroids were secured and injected. This gave her immediate relief, continued for a week, at the end of which time the cramps and nervous symptoms began again to increase. Four more bullock's parathyroids were injected on June 8th, but

POST-OPERATIVE TETANY

on this date also I was able to secure three human parathyroids from the body of a boy of seventeen who died from the results of an accident. These were implanted within forty minutes of his death, inside the sheath of the left sternomastoid muscle. No fat was encountered at this operation, and the sheath was sewed over the glands in a clean graft bed in the muscle. Chloroform anæsthesia was used, and the only noticeable occurrence was that during the induction of anæsthesia the limbs assumed the typical tetany position. The wound healed well by first intention.

On June 19th and 20th she had two short "fits," the characteristics of which were tonic spasm of the muscles without the tetany position, tachycardia, and a short period of unconsciousness, absence of terror and amnesia as to the fit. She was taking calcium lactate and glycerophosphate, fifteen grains of each, at night only, and though her nervous symptoms were still bad, she had no cramps since the operation. A week later her mental condition was very much better. She was for the first time in my acquaintance with her taking an interest in people round her and spoke much less of her "queer feelings." She was discharged from the hospital with instructions to take one of the calcium powders only when she felt it necessary.

On July 15th she reported herself as very well, going out for walks and sleeping well. Two months later she came to see me and reported herself as very well indeed and able to work in the house all day for the first time since her confinement, eating and sleeping well. Mentally her outlook appeared to be very much better, and she had not taken any calcium for three weeks. Chvostek's sign was still present. Three days before her August period she had a slight stiffness in the hands while out walking. The menstruation in September, was normal in every way.

On November 5th she came in again in a very bad condition. She had diarrhoea for three days. Her temperature was 101° Fahrenheit, pulse 120, respirations 60, not obstructed. She cyanosed and very terrified. The hands and arms were clenched, but not in the tetany position—the toes pointed and the calves stiff. Nothing abnormal was discovered in the lungs, the heart apex was external to the nipple line. There was no œdema. The urine contained a small quantity of albumen, no acetone or other abnormal constituent. Syrup of chloral was given without effect. Parke Davis's parathyroid extract was given intramuscularly in 1/10 grain, repeated in two hours without any result. During the next two weeks her condition gradually improved, the respirations getting quite easy, 30 to the minute and the pulse 98. There was no further sign of muscle stiffness since the first night she came in. Some dullness and moist sounds appeared at the base of the lungs. She was very hysterical shrieked with terror if the room door was shut, globus hystericus was present intermittently, and other varying symptoms including blindness. She was absolutely unable to sleep and narcotics had no effect whatever. By December 11th considerable œdema developed in the back and legs. Bullock's parathyroids were injected intramuscularly without any improvement. She began to respond a little to paraldehyde and on the 12th of December I was able to induce a light hypnotic condition in which her normal voice, vision and respirations were reproduced, but relapsed at once on awakening. Two days later her pulse was 80, respirations 30, temperature 98.4° Fahrenheit. The albumen was less and she was inclined to sleep. The nurse had left her bed for a few moments and returning found her dead.

On post-mortem examination, the body was intensely cyanosed, the veins everywhere being congested with blood. The abdominal cavity contained a very little clear fluid. The alimentary canal was normal throughout. The liver weighed 52 ounces and was normal in consistence with some nutmeg appearance on section. The spleen was somewhat enlarged and congested. The kidneys stripped easily of their capsules and showed some thickening of the cortex. The

pancreas was enlarged and very hard. The lungs were soft, not consolidated or greatly oedematous, although they partook of the general congestion. The heart was moderately enlarged and contained post-mortem clot only. The valve orifices were of normal size. The larynx was removed with the thyroid in situ. There was no evidence of oedema or obstruction in the glottis. The thyroid isthmus was enlarged and hard, but not obstructing respiration. The ovaries, pancreas, suprarenals and thyroid were sent to Dr. S. W. Patterson at the Melbourne Hospital for microscopical report. He reports "the right lobe of the thyroid has been removed practically entirely at the operation and the isthmus is now considerably hypertrophied. The thyroid gland in section shows no obvious histological abnormality however. I was unable to demonstrate any parathyroids remaining attached to the neighborhood of the thyroid after cutting sections of many likely portions. The pancreas showed increase of fibrous stroma, more noticeable in sections from the tail of the gland, in which part also the parenchymal cells were somewhat degenerated, staining diffusely with eosin. There is no evidence of small-celled infiltration in the connective tissue. The islands of Langerhans appear normal throughout the gland, but the blood-vessels in all portions were decidedly thickened. Sections of the ovaries and suprarenals present normal appearances."

He examined also for me sections of the sternomastoid muscle at the site of the engrafted glands, and reports: "In the scar of the sternomastoid I found remnants of three small glands which although degenerated have the appearance histologically of parathyroid tissue." His opinion expressed to me was that these glands were probably not functioning at the time of death. A microphotograph of one of them is shown.

The case presents several features of interest, such as the lengthy duration of the condition; its association with the menstrual periods, pregnancy and lactation; the reaction to the various forms of treatment, and the anomalous nature of the relapse which led to her death.

The length of the trouble is unusual in these cases. The trauma was evidently sudden; the damage evidently done at the time of the operation for her attacks came on within a few days of it. Apparently a condition of partial parathyreopriva was produced, the amount of gland substance remaining being sufficient to maintain her in health for six or seven years during which time her attacks did not increase in frequency or severity. It does not seem to have been sufficient to stand the stress of times of glandular strain, such as menstruation, efficiently; and apparently broke down altogether under the severe strain of lactation, for her condition continued to deteriorate after she had weaned her baby. What the exact relationship between the ovarian, parathyroid and other gland functions is, is of course still obscure; but the fact that menstruation, pregnancy and lactation do throw a strain on parathyroid metabolism is well known experimentally. Alquier and Theunveny¹ found that in dogs after partial parathyroidectomy, the menstrual periods were less frequent, and of briefer duration, and pregnancy was more difficult to obtain. Ochsner and Thompson quote a case reported by Pineles in which the operation was performed during pregnancy. Tetany followed in four days, lasted fourteen and recurred with a subsequent pregnancy. The same authors in their book report experiments on animals after parathyroidectomy, showing tetany occurring in sharp attacks during pregnancy and lactation.

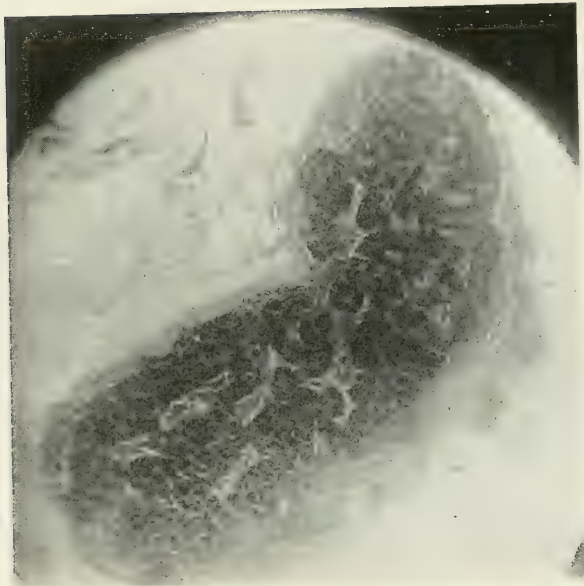


FIG. 1 —Microphotograph of parathyroid graft in fibrous tissue from sternomastoid muscle.

The theory of McCallum claims that these results are due to the loss of calcium suffered by the maternal body in building up the foetus and in producing milk, thus throwing strain on a calcium metabolism already disordered by parathyroid deficiency. It is interesting to note that in the present case, although the menstrual and lactational relationship to tetany correspond with this experimental evidence, the patient was entirely free from attacks of tetany during her pregnancy. In regard to the controversy as to tetany production a recent worker² has published the opinion that calcium deficiency has little to do with the production of parathyroid tetany. He regards methyl cyanamide as the mother substance of guanidines which are responsible for the toxic symptoms and recommends acid therapy regulated to just below the point of acidosis. Shepherd of Montreal³ claims to have succeeded in a permanent cure of a case by large doses of calcium lactate (one drachm every three hours). His case was discharged taking half a drachm of calcium lactate with 1-20 grain of parathyroid extract four hourly. He criticizes W. H. Brown's treatment of his previous case on the ground that the calcium was given in too small doses. We have found that larger doses cause the patient much discomfort and sickness; and Shepherd states that he had difficulty in persuading his patient to continue the treatment owing to its unpleasantness. In any case medical treatment in such a case as the present one would have to be indefinitely prolonged; for the history of the case indicates that the remaining gland substance is not capable of taking up sufficient burden to compensate for the lost tissue. Parathyroid extract by the mouth has failed wherever it has been tried; but seeing that fresh parathyroid has been repeatedly reported as ineffective when given by mouth, whereas we found it to confer very great relief on intramuscular injection, one wonders if the active principle is destroyed in absorption from the alimentary canal, and if a soluble preparation for intramuscular injection would not be a more hopeful procedure.

As to the transplantation of parathyroids, the difficulty is of course to get the opportunity of taking the glands from a human subject. W. H. Brown's experience with parathyroids from animals goes to show that these glands do not survive as grafts in the human body. Eiselsberg⁴ and Stenvers⁵ have reported cases in which parathyroids were obtained during operations for thyroidectomy on other patients and transplanted with successful results. But one would hardly consider such a procedure justified, knowing the great variability of the glandules in size, number and position; and more particularly in the face of such a case as this where tetany supervened after the removal of one lobe of the thyroid only. We considered for some time the possibility of obtaining parathyroids from stillborn infants. According to Erdheim, however, the functioning cells are first found in the parathyroids at about the tenth year of life; and Forsyth states that only in one case has colloid substance been found as early as three months¹; so that it is not likely that this method offers any real hope of success.

The first attempt to graft failed. The glandules were obtained from an exophthalmic case aged fifty. The experience of Eiselsberg and Stenvers

shows that there is no inherent reason against using the parathyroids of exophthalmic patients. And Ochsner and Thompson state that "the parathyroid glandules are in no way associated with the thyroid, save for the relationship of anatomical propinquity, and that functional relationship (which may in certain instances be more intimate than we suppose) which must exist between all important glands that have to do with internal secretion." I think the first graft failed owing to the difficulty of freeing the graft bed from the fat that was so abundantly present. For the second attempt I had no difficulty in securing a good graft bed free from fat. Why, after causing such immediate and complete recovery lasting for five months, they should have ceased to function and have degenerated I do not know. That such grafts do live permanently the cases quoted above prove. The woman reported by W. H. Brown in 1911 is still a normal healthy woman after the lapse of ten years. The relapse was particularly striking in that it showed no features which apart from her history would lead one to suspect tetany as the cause. Her transient stiffness on her readmission was certainly not sufficiently characteristic to arouse one's suspicions. Chvostek's sign persisted throughout, however, and was the only sign remaining when her mental and physical disabilities had completely disappeared to make one anxious about the permanence of her cure. The way in which her mental symptoms cleared away after the second implantation of glands was most striking and brought the mental aspect of the disease into strong relief; which was unfortunately still more strongly emphasized in the relapse which led to her death.

I have not in this paper reviewed the evidence on which rests the belief that the parathyroid glands are separate in function from the thyroid, and that it is by their destruction that tetany is produced, believing that this view is now the generally accepted one. In the *British Journal of Surgery* for April, 1921, however, so great an authority on thyroid work as Mr. James Berry of London declares his frank scepticism as to the separate functioning of the parathyroids.

He states that he has done 1338 thyroidectomies without troubling about the parathyroids, only leaving a small piece of gland behind at the hilus; and he has had no tetany occurring early or late. He considers tetany would only occur in total thyroidectomy because no thyroid substance was left. It was a similar opinion expressed by some men of great judgment and experience in the journals about that time that led W. H. Brown into disregarding the parathyroids in a difficult case in 1910; with the prompt occurrence of tetany as a result.

This case is as far as I can ascertain the only one published in which tetany has supervened on the simple removal of a single lobe.

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- ¹ Ochsner and Thompson: *Thyroid and Parathyroid Glands*, 1910.
- ² W. F. Koch: *Med. and Surg.*, 1918, vol. ii, p. 9.
- ³ *ANNALS OF SURGERY*, Nov., 1912.
- ⁴ Quoted by Ochsner and Thompson.
- ⁵ Quoted by *Lancet*, April 21, 1917.

LETHAL FACTORS IN ACUTE ILEUS*

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WHY do people die of acute intestinal obstruction? What are the factors responsible for the appearance of the symptom-complex of acute ileus and which of them are essentially fatal? These are questions which occur to anyone who reviews a series of such cases. These are questions which must be answered, provisionally at least, if we are seriously to attempt any improvement in the present mortality rate: a rate which can be favorably compared only with those of such surgical catastrophes as thrombosis of the pulmonary artery, neglected gas gangrene and major battle casualties.

But, to make our provisional answers intelligible—even as a basis for controversy—we have first to define the conceptions of intestinal obstruction and of acute ileus which we have used to argue from. For this purpose—

(1) Acute intestinal obstruction may be defined as a local condition associated with the sudden abnormal stoppage—from any cause—of the intestinal current between stomach and anus.

(2) Acute ileus may be defined as a general condition whose symptom-complex appears when acute intestinal obstruction—from any cause—has existed long enough to make its effects manifest.

There is a very practical reason for emphasizing this differentiation and I make haste to state my belief in it lest I be charged with meticulous precision. The proper treatment for acute ileus, whatever its underlying cause, is similar in every case; while the appropriate treatment for intestinal obstruction varies according to its mechanical, spastic or paralytic character. Whoever fails to appreciate the practical difference between obstruction and ileus may readily fail to recall that the latter deserves its proper treatment quite as much as the former. And, again, if he fails to apply his knowledge of this fact he will lose cases of acute ileus that he ought to save.

Acute intestinal obstruction bears to acute ileus roughly the same relation that a wound contamination bears to a systemic infection. One is a local condition and an underlying cause of the other. The other is a general condition, dependent upon and arising from the local lesion. But the general condition appears only when its local cause is active to a sufficient degree and for a sufficient time.

We readily differentiate between a healthy carrier of the bacillus and a person suffering from diphtheria. Why not differentiate, then, between a case of acute ileus and its underlying local condition of intestinal obstruction?

* Read before the Section on Surgery of the New York Academy of Medicine, April, 1921.

† Cases and percentage cited are from human series at the Roosevelt Hospital and from animal series at the Laboratories of the Department of Surgery, Columbia University.

And though one may feel that I have unwarrantably prolonged two lines of argument that are perhaps not parallel, I feel that—for practical purposes of illustration and emphasis—I am justified in doing so.

To develop this conception a little further may I remind you that we do see cases in which we make a tentative diagnosis of intestinal obstruction but in which the symptoms spontaneously disappear in so short a time that operation is not done. An illustration of this is the very recently irreducible hernia with local pain and tenderness and reflex vomiting of which the house surgeon has notified you and which reduces spontaneously while you are on your way to the hospital. There is no ileus symptom-complex apparent in such a patient; even though the local condition persists for several hours and requires operation for its relief. No ileus condition exists and no treatment for it is required. On the other hand, we see cases of hernia which have remained in a condition of unrecognized obstruction or strangulation for an entire day or two days or even longer. They, too, show a tender, painful, local swelling where the bowel is obstructed, but they show other signs in addition. In such cases the symptom-complex of ileus is apparent, for there have been causes active and there has been time allowed for the development of intestinal damage, for poison formation in the obstructed intestine and for general tissue dehydration. In such cases the ileus condition does exist in addition to the obstruction and it does require treatment just as much as the strangulated hernia.

The point I make has quite a definite application to the series of cases a part of whose analysis I desire to offer in evidence, for I have included in the series all the cases of obstructed or strangulated hernia together with the cases of intestinal obstruction from all other causes that have been operated for acute ileus at a large city hospital during the past ten years. I have included them in spite of my appreciation that they are frequently omitted from such a series. I have included them because I wish to emphasize my belief that—in the interest of better mortality statistics for strangulated hernia as well as for other mechanisms of the underlying cause of acute ileus—they should be so included. I have included them in order to make the point that acute ileus resulting from strangulated hernia deserves treatment quite as much as acute ileus arising from the common post-operative mechanisms such as bands and adhesions.

The point is this: ileus is ileus whatever mechanism be the underlying cause (and I use this term mechanism in its broadest sense). Both the ileus and the underlying cause deserve prompt treatment.

The facts are these: In strangulated hernia ileus, the hernia is the prominent feature. It receives prompt treatment and the ileus does not. In ileus that arises from other causes than external hernia, the ileus is the prominent feature and neither the ileus nor the underlying causes receive prompt treatment.

Evidence in support of this statement can be found in the mortality statistics of intestinal obstruction from almost any general hospital. The

death-rate varies from thirty odd to sixty odd per cent. and averages between forty and fifty per cent. Now our own operative statistics show that the mortality is less than twenty per cent. where operation follows within twenty-four hours of the onset of symptoms, and over seventy per cent. where operation is delayed for over seventy-two hours. Even at the end of forty-eight hours after onset, operation gives only a little better than a fifty per cent. chance of recovery. Here then is two-way evidence that prompt treatment is needed and that it is not often received. Only thirty-three per cent. of our cases in whom the elapsed time could be satisfactorily calculated were operated within twenty-four hours after onset of symptoms.

Of course it must not be thought that this was entirely our fault. As matter of fact only twelve per cent. of the case series originated in the hospital: the rest applied from outside and were mainly "emergency operations" done as soon as the attending could reach the hospital and have the operating room prepared. I must not be understood to say that these average mortalities set forth on a time basis, apply to every individual case. If they did they would not be averages—for we all know how the individual reaction of different patients varies. For example—a girl of sixteen, in our human series, died twenty-four hours after the onset of ileus symptoms which began forty-eight hours after removal of her appendix. Autopsy showed a pelvic abscess to which a loop of ileum was fastened by recent adhesions in a tight double angulation which absolutely occluded the lumen but gave no gross evidence of interference with the mesenteric or intestinal circulation (Fig. 1). On the other hand, an old lady of sixty-four was in operable condition at the end of seventy-two hours after onset of symptoms, survived a resection of gangrenous intestine which had been strangulated in a ventral hernia and was able to leave the hospital at the end of four weeks.

One sees the same individual variations among animals in whom obstructive lesions have been experimentally produced to simulate those of humans. For example, in a certain series of ten animals, last year (1920), one, whose intestine had been obstructed by a ligature carefully placed to avoid injury to the mesenteric blood supply, died within forty-eight hours of the onset; while another, in which an exactly similar obstruction technic had been followed, but who had several saline hypodermoclyses, was in sufficiently good condition at the end of six days to survive an intestinal resection from which he recovered. A third animal (the control in the same series) whose intestine had been transversely divided and the ends inverted, survived almost eight days without any treatment whatsoever. In another series of six animals, this year (1921), with obstructions as nearly similar as possible, one died within forty-eight hours and one lived six days with no other help than three saline hypodermoclyses. It is perfectly clear, then, that here, as in other serious sicknesses, individual variations in resistance, or—if you prefer the biological conception of disease—personal variations in the adaptability of an individual's tissues to altered environment partly determine the outcome.

Let us set down poor adaptability or—more familiarly perhaps—(1) low resistance as the first factor in the high mortality of acute ileus. This like the others is a variable factor and it includes all complications liable to accentuate it. It is for the most part beyond the surgeon's control, but a serious effort ought to be made to estimate the individual resistance in each case, and to plan or to modify the treatment in accordance with the estimate. Whether the resistance be high or low, however, there are two other factors which, if allowed to remain active, will in the end prevail over the stoutest efforts of the organism to adapt itself. They are (2) intestinal damage and (3) the formation of poisons within the intestine. Whether these go hand in hand—as one might naturally imagine—or whether they are in part independent is not as yet decided; and it is interesting to review some of the evidence one may adduce as to the independence or the preponderant effect of either.

Now intestinal damage, basically, means interference with the intestinal blood supply. It is difficult to imagine any intestinal injury that does not interfere with the blood supply. And, conversely, it is difficult to imagine any interference with the intestinal blood supply that would not result in damage to the intestine. We all are probably ready to admit that, in general, marked intestinal damage in obstruction cases is more likely to result in early death than is slight intestinal damage; that volvulus or mesenteric thrombosis is more rapidly fatal than simple, single obstruction by band or angulation. And, similarly, on observing a piece of gangrenous, strangulated intestine, we would be willing to suppose its contents to be more poisonous than those of a viable portion occluded by simple angulation. Yet we have clinical and experimental evidence to disprove the universality of such conclusions. We find exceptions to the general rule and we must try to adapt our hypotheses to explain them.

Among humans, such an exception was illustrated by the young girl whose case I cited a few moments ago. She died within twenty-four hours of onset of symptoms, yet autopsy showed an intestine only moderately dilated and with no signs of gross damage (Fig. 1). From its appearance one would have expected her intestinal contents to be relatively non-toxic; and we did indeed ascribe her early death to the complicating status lymphaticus whose lesions appeared at autopsy. Contrary to expectations, however, a moderate dose of the sterilized filtrate from her intestinal contents injected into the jugular vein of a dog proved rapidly fatal. He died within three and one-half hours with evidence of the most intense gastro-enteric disturbance shown by blood-streaked vomitus and stools, together with bloody intestinal content and a sero-sanguineous peritoneal effusion which autopsy disclosed. Here, evidently, the appearance of the intestine was no criterion for the toxicity of its contents.

A similar exception appeared in our animal series this year. Thinking to secure some highly toxic intestinal contents for a class demonstration, I made an experimental volvulus of the small intestine; and insured the

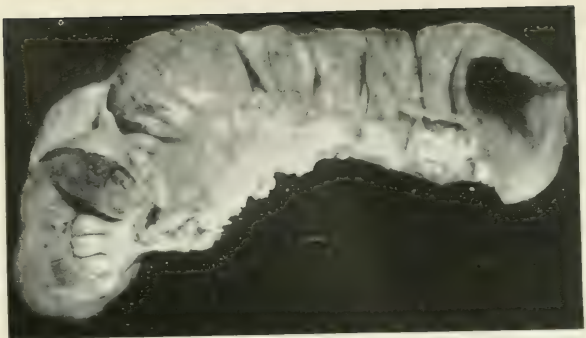


FIG. 1. Surg. Path. No. 6085. Human ileum obstructed by adhesion and angulation. Appearance of intestine relatively normal. Contents highly toxic.

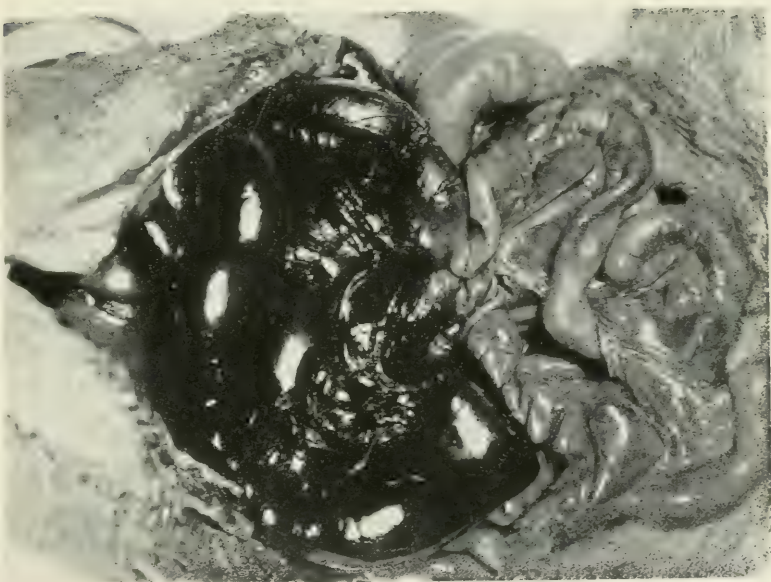


FIG. 2.—Dog No. 1668 (1921).—Experimental volvulus of ileum. Appearance of intestine gangrenous. Contents relatively non-toxic.

complete blood and contents stasis of the loop by tying a tape around its stem. The animal died within about eighteen hours. The strangulated loop was apparently gangrenous and the peritoneal cavity full of bloody exudate (Fig. 2). To our surprise and chagrin, however, the sterilized filtrate from the contents of this loop showed practically no toxicity upon injection into the jugular vein of another animal. Here, again, the toxicity of the intestinal contents and the appearance of the intestine itself bore little relation to each other.

Now, although the best supported theory at present—relating to the cause of death in acute ileus—is one which supposes the fatal absorption of poison from the intestine, it is difficult to believe that this animal died from that cause. In the first place there was no poison demonstrable in the intestinal content; and, in the second place, the drainage from the loop into the systemic circulation was absolutely shut off by the tape ligature which tightly compressed the neck of the involved loop. It is of course possible that the sero-sanguineous peritoneal exudate or transudate (whichever it is) may have been poisonous, and that such poison (if present) was introduced into the circulation via the peritoneal lymphatics with fatal result. Experiments are in train to test this hypothesis. But it is simpler to believe that—in cases of this sort—where massive gross damage is done to the intestine, its blood-vessels and nerves, another deadly factor is apparent, (4) shock.

There have been so many contradictory explanations of shock offered that we must—most of us—feel that we have still much to learn regarding its pathology and its underlying cause or causes. And it may possibly be that what I here call shock is the result of the rapid absorption, via the peritoneal lymphatics, of poisons from the intestinal wall which *may* be present *there* before they are demonstrable in the contents of the lumen. If gross intestinal damage went invariably (as it does not) parallel with the presence of demonstrable poisons in the intestinal contents, the early poison absorption theory alone would be acceptable. But I prefer to believe, at present, that an element of shock—shock from some other cause than the absorption of intestinal poison—plays a major part in the fatal outcome of certain cases of acute ileus.

This curious condition which none of us can satisfactorily explain but which all of us can sufficiently recognize under the name of shock, certainly does appear relatively early in the cases of obstruction where a portion of the intestine has had its mesenteric blood supply occluded by volvulus, mesenteric thrombosis or other mechanisms of strangulation. And, from observations upon series of cases in humans and in animals, we are fairly safe in saying that the more sudden the onset of the blood stasis and the larger the amount of intestine involved, the greater the accompanying shock.

Personally, at any rate, I am at present convinced that shock is a preponderant factor in certain cases of early death from acute ileus.

Now, in order to get an impressionistic view of the last factor which I want to consider, let us think for a moment of the human or animal body

as an oversaturated watery solution. A solution whose precipitate has so thickened and hardened at the periphery as to effectually enseat the aqueous content. Since the solution is normally of the proper density, in its different parts, to carry on satisfactorily the processes of life within the body, we may suppose that any measurable alteration from the normal density will interfere with the optimum conditions for bodily health. And, further, that if such alteration should be extended to a degree beyond that to which the body's capacity for adaptation to it extends, serious bodily damage would result.

At all events we are frequently forced to recognize the striking damage resulting to the tissues directly involved—and to the entire body—from that most rapid dehydration due to a burn. And, to a lesser degree, we can, by closer observation, recognize various instances of lesser and perhaps temporary injury to the body due to unbalanced lowering of its aqueous constituent from various causes. In acute ileus, where the output of water by urine, sweat, respiration, and especially vomitus, is frequently much greater than the intake, this type of tissue damage is often very prominent; and I want to set down, as last but not least, among the factors which predispose towards a fatal outcome in acute ileus, (5) dehydration.

Some at least of these lethal factors appear to be interdependent or to react upon each other. For example, the degree of shock appears to depend upon the amount of intestinal damage, and personal idiosyncrasy (poor individual adaptability) may determine the rate of tissue dehydration and of poison formation. But each of the factors is variable and the preponderant effect of one, in one case, and of another, in another, should not be allowed to interfere with our realization that all the factors are present in almost every case of acute ileus and that they deserve treatment.

In this paper, so largely speculative and propagandist in its form, it would be inappropriate to include the protocols of animal experiments and the analyses of case series from which arguments have been drawn or examples cited. These have appeared, or will appear, elsewhere. But it would be misleading, as well as ungrateful, to omit appreciative mention of the brilliant and painstaking experimental studies of Dragstedt, of Hartwell, of Stone and of G. H. Whipple and their collaborators whose published work has been of such value in exciting our interest in and adding to our knowledge of the ileus condition.

And, finally, having outlined the factors which, in the patient's body, must be estimated and allowed for in our plan of treatment, it would be unfair to forget those factors which we have to combat in our own minds before we can effectively translate our plan into action. No honest and intelligent practitioner can critically survey his own results or those of others in this field without feeling the conviction that he must, in future, make additional efforts to protect acute ileus patients against his faults as well as against their own failures. For timidity and delay on the doctor's part are just as fatal factors in acute ileus as any that we have ascribed to the sick man's own economy.

THE CAUSE OF DEATH IN HIGH INTESTINAL OBSTRUCTION*

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MODERN surgery has made rapid progress in recent years. The many aids to an accurate diagnosis, and the perfected aseptic technic, have greatly reduced the mortality of a number of acute abdominal conditions. Acute conditions such as appendicitis, gall-bladder disease, and perforation have yielded to surgical skill. High intestinal obstruction is still taking too great a toll of human life. The mortality rate in the hands of the best of surgeons is approximately fifty per cent., and if accurate statistics were available from the entire country, I venture to say that this figure would be much higher. In fact, Deaver, in a recent lecture, placed it at sixty per cent. Guillaume⁷¹ has compiled 382 cases of acute ileus, and states that the mortality was sixty-three and two-tenths per cent.

The symptoms of high obstruction are chiefly those of a profound toxæmia, plus collapse and the symptoms of an acute abdominal storm, pain, tenderness, rigidity and vomiting. But as these symptoms point to a possible obstruction, so also do they indicate acute pancreatitis and acute fulminating peritonitis; therefore a differential diagnosis of these conditions is not only difficult but practically an impossibility.

The body is overwhelmed by the toxin and death is a matter of hours. It is true that the condition is primarily a question of mechanical interference, but surgery aimed at mechanical relief, except in the first hours of onset, is not sufficient. Richardson⁵¹ reports that in a series of forty-six cases, operated approximately within the first forty-eight hours, he had a mortality of thirty-two and one-half per cent.; and that in fifty-four cases, operated after two days, he had a mortality of forty-eight and one-tenth per cent. He makes a plea for early diagnosis, but further observes that the great difficulty lies in the absence of physical signs confirming a suspicion of obstruction.

Surgeons differ widely as to the best treatment; some eviscerate and by means of a Monk's or Moynihan's tube empty the affected loops; some prefer an enterostomy. But whether he believes in merely relieving the obstruction, in evisceration and an emptying of the loop, or in an enterostomy, the fact remains that the results are far from satisfactory, the mortality high, and death is the result of the toxæmia. In view of these facts it becomes highly desirable to find the source and nature of the toxin involved.

There have been many theories advanced as to the source and nature of this toxin, and the method by which it produces death. Amussat,² in 1839, first stated that death from occlusion of the intestine was brought about by intoxication from

* Read before the Philadelphia Academy of Surgery, December 5, 1921.

the stagnating and decomposing intestinal content. Humbert,²⁸ in 1873, repeated this assertion. Kocher,³⁰ in 1877, produced a strangulation of the intestine in rabbits. At death he could not demonstrate a peritonitis; therefore he does not believe that death is caused by a bacteraemia but by an intoxication. He also showed that the condition of the patient could be improved by removing the intestinal content and washing the stomach, or by an enterostomy. He thus gave the first experimental support to the theory of auto-intoxication.

Reichel,³³ in 1886, published the results of his researches, in which he ascribes the early severe general disturbances and death to an infection of the peritoneum. But he does not blame infection alone, because in obstruction there is an increased peristalsis of the afferent loop, while in infection there is paralysis of the intestine. At autopsy we miss the signs of a peritonitis. Kirstein,³⁴ in 1887, made an infusion of the loop contents, and injected 15 to 20 c.c. This produced severe gastro-enteritis, collapse, and death in from two to eight hours; when injected into the peritoneum a peritonitis resulted; intravenous injection into two rabbits caused death in from seven to twenty-four hours. He used rabbits and cats. Fifteen to thirty minutes after injection the animals showed a fall in temperature, anxious expression, hair on the back erect, diarrhoea and death. In the cats there were the additional symptoms of vomiting and convulsions; in the cats the mucosa of the colon and ileocaecal region showed ecchymoses, and these were also found scattered throughout the mucosa of the ileum. His attempts to determine the method of formation and absorption of the poison did not succeed. To determine the rôle played by bacteria he used hibernating animals—the hedgehog; in these he found the intestine sterile after six months of sleep. He then caused a strangulation and found that the second day after operation the animal was awake and took milk. The animal died on the sixth day. Autopsy did not show a peritonitis. In the portion of the intestine above the strangulation the vessels were dilated, the mucosa injected and ecchymotic; the lumen contained twenty c.c. of brownish fluid; inoculation showed bacteria throughout the entire intestine. He concluded that the results obtained were due to the initial bacteria-free condition of the bowel, which later became infected from the milk. The toxic action of the content of the afferent and efferent loops did not differ, though the conditions for the development of the toxin were better in the afferent loop.

Bouchard,⁴ in 1887, assumed that death was caused by an auto-intoxication and upon this hypothesis he would explain the general symptoms that arise in ileus and in incarcerated hernia. He compares the similarity of the symptoms in these conditions to those of cholera, and for further proof calls attention to the presence of an albuminuria. Bokai,⁷ in 1888, took as a basis for his experiments the fact that fatty acids in the intestine act as irritants, causing peristalsis, and that if, for any reason, they are produced in excess, as in obstruction, they cause increased peristalsis and symptoms of inflammation of the wall of the gastro-intestinal tract. He states that the higher degree of intoxication is brought about by the products of putrefaction of the protein.

Talma,⁶² in 1890, sought the cause of death not in inflammation nor in anatomical lesions nor in a disturbed function of the diaphragm. From his experiments he concludes that the intoxication in these and similar cases is caused by the disturbance of the entire organism, and that the immediate and distant effect of the over-filling of the stomach is the reason for death in ileus. Kraft,³¹ in 1891, found that after strangulation cultures of the heart-blood and peritoneum remained sterile, and concluded that death is due to an intoxication. Reichel,³³ in 1892, rejected his former views and maintained that in straight occlusion, in spite of the distention present, there was no passage of bacteria through the intestinal wall. Nicholaysen,⁴² in 1895, collected the intestinal content from a case of obstruction, filtered, and

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injected into a mouse and a guinea-pig; it killed in each instance. He cultured the heart-blood and peritoneum and found both sterile.

Gley and LeBas,²⁴ in 1897, used Witte's peptone and decided that the immunity resulting from injections depended upon the dose per kilo; they failed in their attempts to confirm the statement that a preliminary injection confers an immunity for twenty-four hours. They state that proteose injection caused an increase in lymph flow, and decided that the toxin is not a proteose because it did not possess a lymphagocic action. Chittenden, Mendel and Henderson,⁹ in 1898, reported that after the injection of a proteose the coagulation time of the blood is reduced and that there is a temporary immunity produced but this immunity is not complete, lasting only about an hour. Chittenden¹⁰ further reports that peptones and proteoses cause a fall in blood-pressure and a disintegration of the leucocytes. This disintegration releases nucleo-protein and histon, with the production of a clot-retarding substance. Proteose injection caused an acceleration of the lymph flow; if the lymph was collected, then the clotting of the blood was barely affected, while that of the lymph was delayed, and the lymph changed in character, the lymph becoming reddish in color.

Nesbitt,⁴² in 1899, made a study of the intestinal content above the occlusion of the small intestine of a dog. He found that if the animal was fed food rich in lecithin he obtained cholin and neurin, and believed that the neurin was the lethal factor. Buchbinder,¹ in 1900, showed that the obstructed loop was rapidly filled, not only by the content but by a more or less severe transudation into the lumen, especially if the venous flow were interfered with. If both veins and arteries were compressed, transudation did not occur. It appears that the intestinal wall is not permeable to bacteria or microorganisms, and he is convinced that he has shown in a conclusive fashion that even disturbances of the circulation to a high degree do not permit the passage of bacteria through to the serosa and into the peritoneal cavity. For this, wandering through deeper injuries are necessary, and the beginning of irreparable injury with consequent gangrene first permits this to occur. He repeats that the intestinal wall first becomes permeable after injury and gangrene.

Kukula,^{29, 30} in 1901, in his first experiments occluded the intestines of dogs, and injected the contents into cats; he also obtained the material from ileus patients and injected this into animals. He found that these contents were toxic, and not specific for species. He first assumed that the symptoms were reflex symptoms, due to irritation of the nerves of the intestine. The second assumption was that auto-intoxication was the causative factor of the symptoms, but he states that this is only an unsupported hypothesis. Third, he investigated the normal intestinal content and the urine. He divided the toxic substances found into two groups, arising in normal or excessively increased processes of breakdown, according to whether it is due to a breakdown of the carbohydrates or to the putrefaction of the proteins. The nature of the toxic substance is obscure, but it may be advantageously extracted with amyl alcohol. This extract is as toxic as is the first filtrate of the intestinal content, so the toxin is unchanged by the method of extraction. Borszky and Generisch,⁵ in 1902, published a report of their experiments, in which they attributed the toxin to the bacillus coli, and state that this organism is present in the blood and peritoneum before there is any damage to the intestinal wall. Albeck,¹ in 1902, tested the wall of the loop as to its permeability to bacteria; he concluded that death is due to a toxin. He found at autopsy that the intestinal mucosa is ecchymotic. The work with the toxin showed that it is soluble in water, resists boiling, and passes through a Chamberland filter. He concludes first, that death in strangulation not infrequently occurs without peritonitis, and results exclusively by poisoning from the intestine; second, that the site of the formation of the toxin is not only the afferent intes-

tine, but also the strangulated loop, and in many cases is found chiefly in the loop.

Wrzosek,⁴⁶ in 1904, concluded that bacteria arising from the intestinal tract get into the mesenteric glands and other organs. He found that if he fed prodigious cultures and then tied the thoracic duct, he could not recover the organism in the blood or organs. Clairmont and Ranzi,⁸ writing in the same year, stated that the kind of animal used for the injection of the toxin exercised no real influence upon the result, provided only the proper proportion between the body weight and the dose of poison used were maintained. They filtered the intestinal content through a Pukal or Reichel filter, and tested the filtrate for bacteria; if these were present, the material was again filtered. They found the same toxin in the content of human ileus cases as in the content obtained from the obstructed loop of animals. They studied the rate of resorption of the upper intestine, and found that it is more active up to the first half of the time the animal lived; after this it is slowed. They made bouillon cultures of the content in ileus under aerobic conditions, and obtained the same result as from the original content. Cultures made under anaerobic conditions failed to show the toxin. They state that the toxin possesses hæmolytic, cytolytic and heat-resisting properties. In their opinion the toxin is bacterial in origin, different poisons arising from different organisms, and there may be a symbiotic relationship.

Charrin¹⁸ at this time published his conclusions, in which he maintains that in its normal state the digestive juice contains innumerable poisons. Helmburger and Martini,⁴⁹ working with transudates, state that in the solution of this problem, one is confronted by difficulties, chiefly those of reproducing the disease, and especially by bacterial contamination of the material. They show that slight disturbances produced in the intestinal wall by interference with the circulation are not sufficient to render the intestinal wall of rabbits permeable to bacteria, and that the musculature, apparently, offers the greatest resistance. They conclude that absolute necrosis is necessary, and that lesions that have lost their impermeability to bacteria cannot be recovered from.

Magnus-Alsleben,⁴¹ in the report of his results of his investigations, states that in the content of the upper small intestine of a dog, as well as in the mucosa, there is found, after feeding various kinds of meat, and apparently after feeding bread, fats and starches, but not after feeding milk protein, a toxin substance; this toxin produces in rabbits, upon intravenous injection of the smallest doses, a general central paralysis with subsequent convulsions; death generally resulted from a stoppage of respiration. Many times during the period of paralysis, rapid recovery took place, after which the animal was immune for several hours to further injections. This effect does not follow the injection of similar doses into the portal system. Boiling in an acid solution destroys this substance. He states that the content of the entire small intestine contains, after every kind of diet, a substance which in the smallest doses produces an immediate and rapid fall in blood-pressure; this effect lasts for one minute at the most. This depressor substance is not detoxified in the liver, but is destroyed by boiling in an acid solution. He rules out the pancreas as the source of the toxin, having tested the juice obtained from a pancreatic fistula; but calls attention to the fact that the fluid flowing from such a fistula contains only trypsinogen, and no active trypsin. He states that the toxic effects are like neither neurin, proteose or peptone, nor the basic products of protein splitting alone. He believes that the intact mucosa and the liver act as retoxifying agents.

Roger and Garnier,^{47, 48, 49, 50} in 1905 and 1906, first used rabbits and determined the coefficient of toxicity. They found that ligation of the rectum was not as toxic as a higher ligation. In perforation the toxicity became sixteen times normal. They caused peritonitis by injecting anaerobic organisms, and obtained a toxicity twice the normal. They made a solution of the intestinal content in

alcohol, and found that the material dissolved was not toxic, but that a watery solution of the precipitate produced diarrhoea. This watery solution, however, was less active than the primitive liquid. They next used dogs, and after a fast of forty-eight hours, fed them 100 to 1000 grams of meat. The dogs were killed and the contents measured. This content was passed through linen, centrifuged and filtered. The extremes of the lethal dose were from 0.41 to 3.4 c.c. per kilo. They found the blood liquid and increased the resistance by injections of an extract of leech. The duodenal content was most active; injection into a peripheral vein was 0.14 times more toxic than injection into the portal vein. They found that the material dissolved in alcohol had a high toxicity for dogs, and decided that there must be a plurality of toxins. The alcoholic solution caused death without convulsions and increased the lymph flow; the watery solution of the alcoholic precipitate caused diarrhoea and death. They found that the toxicity diminishes if the animals are fed milk, and is one-ninth as toxic as after meat feeding. They next made extracts of the different portions of the gastro-intestinal tract; they found that the stomach and cæcum had an equal toxicity, and were less active than the duodenum, jejunum and ileum. The colon was more toxic than the stomach and cæcum, and had the property of producing hemorrhages in the Peyer's patches; this did not follow injections of any of the other preparations. Extracts of the ileum and appendix caused clotting in the right heart; an extract of Peyer's patches showed this clotting power, but it was lost in the remainder of the ileum. They state that the toxicity has no relation to putrefaction, and cite, for example, that the duodenum is more toxic than the large intestine. They injected the pancreatic secretion, and found it non-toxic. The duodenal content was slightly toxic, when mixed with pancreatic secretion, the mixture became quite toxic. They believe that the toxicity of the intestinal content depends upon the food, and that the secretions are only slightly toxic. They found that after feeding meat, if there was a large amount of the gastric juice present in the duodenal content, this content was less toxic; they found that incubation increased the toxicity, and they have, by these different processes of treating the content, been able to modify profoundly its toxicity. They conclude from their experiments that as a means of defense the liver is only slightly active; that the most important defensive rôle is played by the intestinal mucosa; this must be intact from the point of function, for if it is impaired, or its vitality modified, autolysis results.

Von Khautz,³³ in 1908, concluded that the supposition of pure bacteriæmia as the cause of death in mechanical and paralytic ileus, without a simultaneous peritoneal infection, is improbable. It is to be assumed in such cases that death is caused by toxic substances in the intestinal content.

Draper-Maury,⁴⁰ in 1907, regarded it as conclusively demonstrated that death following duodeno-jejunal obstruction, and probably acute pancreatic disturbances other than infections and traumatisms, and death associated with symptoms known as acute gastric dilatation, and following certain operations on bacterially clean surgical fields in which the hepatic ducts have been invaded, all these now uncorrelated and little understood deaths due to a common, underlying cause as yet not defined. He believes that death in ileus is a physiologic one. Physiologic death comprises not alone that which follows certain substances by removal of their secreting cells, but also that brought about by mechanical interference with detoxication of the normal secretions of the body. This would suggest an internal secretion of the duodenum. He starts with the hypothesis that obstruction of the lumen works no ill to the organism save through an interference with the physiologic exchange or balance of the duodeno-jejunal secretion.

Cybulski and Tarchanoff,⁴¹ in 1907, stated that the toxicity depends upon the secretions poured into the upper intestine, especially the pancreatic juice.

Braun and Boruttau,³ in 1908, stated that they did not believe that a poison existed, because tracings taken just before death did not show convulsions, arrhythmia or other stormy manifestations pointing toward a poison. On the contrary, everything pointed toward a gradual extinguishing of life. The increase of resorption in the afferent loop of intestine, assumed by Clairmont and Ranzi⁸ in the first nine hours after the production of an occlusion, they do not consider correct; on the contrary, the resorption is generally slowed from the very beginning, as they have determined by the injection of strychnia into the lumen of the intestine above the obstruction. Indeed, the delay in many cases was so great, the resorption so slow, that an otherwise absolutely fatal dose is not able to bring about death. Where no infection is demonstrable and death nevertheless occurs, they hold that the severe functional disturbances in the abdominal cavity suffice to cause death by causing a cerebral anæmia, due to bleeding into the splanchnic area. They further state, in their discussion of the toxicity of the intestinal content, that the truth cannot lie in the assumption of the effect of bacteria and putrefaction; but one must sooner think of the breakdown products of the food by the intestinal ferments, or indeed, of these ferments themselves.

Draper-Maury,¹⁰ in 1909, stated that the bile is in no way connected with the cause of death, but considers the pancreatic secretion the lethal agent. Sauerbruch and Heyde,¹¹ in 1909, produced parabiosis by uniting the peritoneal cavities of two animals, and then produced an ileus in the one. They ruled out the possibility of peritoneal infection going from one to the other. A few hours after operation the temperature in both animals rose; later the temperature of the operated animal fell, but its parabiotic mate preserved an increased temperature up to the death of the operated animal; if the living animal was then removed and sewed up, the temperature returned in a few days to normal. This is explained by the relative amounts of toxin, in that the second animal only gets sufficient amounts of toxin to cause the rise of temperature, and not the fall and the fatal effect.

Combe,¹² in 1909, was an ardent adherent of the auto-intoxication theory. He assumed a threefold protection against intoxication, *i.e.*, the intestinal mucosa, the liver, and the antitoxic glands, the hypophysis, the thyroid and the adrenals. Dale,¹⁶ in 1910, compared the action of Witte's peptone, the effect of which had been considered by some to be analogous to the effect of the obstruction toxin, to that of his Beta-I, or histamine, and considered that the effects of the peptone were similar to, but not necessarily identical with, the effects of the histamine. Esau,^{21, 22} in 1910, found that if one resected a loop of the intestine, leaving its mesentery intact, closed the ends and transplanted this loop beneath the skin, having restored the continuity of the intestine by an end-to-end anastomosis, symptoms appeared, and death might result. If one then loosened the suture of one end of the excluded loop, large amounts of foul content escaped and the dog recovered rapidly. This, he holds, strongly proves the autointoxication theory. He states that resorption diminishes with the course of ileus, but that a short period is sufficient to overload the animal with toxin arising from the stagnating content. He thinks that relatively small amounts of toxin would suffice to rapidly produce an irreparable injury to an organism on which other different harmful factors are working. He concludes that it is not possible to have closed, excluded loops in the abdominal cavity or extra-peritoneally. Wilms,²³ in 1910, concluded that the symptoms were due to reflex nerve irritation.

Murphy and Vincent,³⁰ stated that interference with the circulation of the obstructed intestine is the vital factor in the production of the symptoms of ileus. Enderlein and Hotz,²⁰ in 1911, presented their resorption theory in peritonitis and ileus. Their results show that the resorption power of the obstructed loop is considerably lessened and point to the conclusion that the portion of the intestine concerned in ileus is harmed in its resorptive power. Using five per cent. sodium

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chloride solution, they found that there was an increased excretion into the loop in ileus; the quantity may reach double that found in the efferent loop. Their work shows another important result, in that they found that the power of resorption of the entire intestinal tract is lessened.

In 1912, 1913 and 1914, Stone, Whipple and Bernheim,^{54, 55, 56, 57} published a great many papers on the results of their investigations. In their earlier work they found that death occurred usually within forty-eight hours; a microscopic study of the organs of these animals showed them to be normal. They showed that the occluded loop is not essential to life, and that drainage of an occluded loop plus irrigation, may save life. They adopted the secretion theory as the most probable, and scout the circulatory disturbance theory of Murphy and Vincent. They found that the toxin is not destroyed by heat, autolysis, or pancreatic digestion; it resists putrefaction for a few days, and it does not stimulate pancreatic secretion, as does secretin. Blood from animals moribund from the effects of an obstructed loop is not toxic to normal animals. Autolysis of the normal mucosa did not produce the toxin. They believe that sub-lethal doses protect against large doses, and probably against the closed loop. In 1913 they showed that the toxic substance is absorbed from the mucosa, and not from the lumen. The normal mucosa did not contain this toxin; destruction of the mucosa prevented the formation of the toxin. In one experiment noted (56, p. 315), the entire intestinal mucosa was removed from a dog fatally poisoned, autolyzed for seven days with toluol; upon injection, it proved inert. In 1914 they showed that with circulatory disturbances, food derivatives, gastric, pancreatic and biliary secretions excluded as a possible source, the dogs died with the characteristic symptoms; the autopsy findings were typical, and suggested an intoxication. The content of the closed loop is highly toxic when injected into normal dogs, and the reaction resembles that of dogs with a closed loop. They hold that the toxin is formed by the mucosa of the closed loop, and that resorption from the mucosa is the prime factor in the intoxication. The cause of the perversion of the secretion is not explained. They believe it possible, by using sub-lethal doses, to confer an immunity, and that this immunity is produced by the action of the parenchymatous organs. They have demonstrated that absorption of the toxin from the lumen is a negligible factor.

Hartwell and Hoguet,^{26, 27} in 1912, maintained that the symptoms were caused by dehydration of the tissues, with resulting disintegration, and that if the water were replaced, life would be prolonged; but that if the distention of the bowel above the obstruction became so great that the mucosa was damaged, the dogs could not be kept alive with the salt solution. McLean and Andries⁵⁹ believe that death in high obstruction is not due to a toxæmia, neither from bacteria nor altered physiologic secretion. They state that a depletion of the vascular and lymph system, causing a grave disturbance in the circulation, is a prime factor, and that a pathologic change in the sympathetic nervous system, probably a loss of control, is a contributory cause. McKenna,⁵⁸ in 1913, held that the toxin is the result of a disturbance of the physiologic balance of the normal intra-enteric secretion from the duodenal mucosa. The fatal factor in general peritonitis may be due to this duodenal secretion; the results are the same whether the ileus is produced by mechanical obstruction or by paralysis, and he recommends an early jejunostomy.

Sweet,⁶⁰ in 1913, called attention to the relationship existing between the pancreas and the adrenals, and to the striking clinical resemblance between high obstruction and acute pancreatitis. Draper,¹⁴ in 1914, repeated his assertion that the cause of death was not bacterial, but truly autotoxic, from the cells of the epithelium. A microscopic study of the heart, the liver, the kidneys and the intestine showed only a capillary dilatation. He showed that the decrease of the

water content of the tissue of dogs with a duodenal obstruction is about equal to that following pilocarpin. These toxins are partly eliminated by the stomach and the colon. He found that if the animals with obstruction were fed the epithelial cells of the small intestine of healthy animals, they survived nearly twice as long. Davis,¹⁷ in the same year, working with cats and dogs, found that the cats exhibited a higher immunity to the closed loop toxin; also that the dogs would react to the toxin obtained from the cat.

Murphy and Brooks,³⁷ in 1915, in summing up their work, report that they believe the toxin to be produced by bacterial growth, and that it may be formed in any portion of the intestinal canal or in the gall-bladder. Its mode of entry into the circulation is by way of the thoracic duct, and an interference with the circulation is an essential factor in allowing absorption. Sweet,³⁸ in 1916, stated that the finding of the poison in the isolated loop is no proof that it is formed there, as it is possible that it is formed elsewhere and then excreted into the loop. He, with Peet and Hendrix,³⁹ question the statement of Whipple and his co-workers as to the formation of the toxin in the obstructed loop, and state that it may be formed in the afferent loop, which was functionally obstructed in the experiments reported by Whipple and his associates, and then be excreted into the obstructed loop. The destruction of the mucosa of the isolated loop with sodium fluoride proves nothing, because by destroying the mucosa, one destroys the excreting agent.

Whipple, Rodenbaugh and Kilgore,⁴⁰ in 1916, attacked the dehydration theory of Hartwell and Hoguet, and cited as proof against this theory that dogs which had been dehydrated with pilocarpine and purgatives showed no signs of intoxication. In their studies of the properties of the toxin, they found that it did not produce anaphylaxis in the guinea-pig; that it produced a slight immunity; that it was more or less removed by a Berkefeld filter; that autolysis with normal intestinal mucosa destroyed it only after a period of eight to twelve months; that it resists pancreatic and ereptic digestion, and in these respects it resembles a hetero-protease.

Dragstedt, Moorhead and Burcky,¹⁹ in 1917, stated that they did not believe that the toxæmia was the result of increased absorption; and for evidence against the bacterial origin and the theory of cellular activity, they point to the fact that it is not manifest in typhoid, dysentery and ulcer, nor is it manifest in congenital atresia until after feeding takes place. They experimented with sterile closed loops, using as an antiseptic agent sterile water and ether. Of twenty-five dogs thus operated upon, sixteen died of perforation and peritonitis. A few of the remaining were killed, and the examination of the fluid content of the loop showed *bacillus coli*. One case of perforation did not show a peritonitis. In another series they prepared the sterile loop, and occluded the blood supply. In one case autopsy showed that the loop had disappeared; in the second case death resulted from necrosis of the loop. When the loop was of the duodenum, death resulted from the sterile loop in apparently the same time as from the non-sterile loop. They give as possible factors in the production of death in the sterile duodenal loops, first, as the duodenum is chiefly secretory, they were unable to establish an equilibrium between secretion and absorption, and second, the arrangement of the blood-supply differs, so that a slight distention causes occlusion. They assert that these factors, and not any peculiarity of the secretions of the glands or of bacterial flora, is the cause of death. They ruled out, to their satisfaction, the question of the toxicity of the normal secretion, perverted secretion or aberrant activity of the cells, by isolating a loop, sterilizing it, and dropping it into the abdominal cavity, leaving the ends open; fifty per cent. of the animals lived. They conclude that bacterial activity, plus necrotic tissue, or the absorption of the toxic products resulting from the action of putrefactive bacteria upon necrotic

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tissue, is the important factor in the rapid death in simple, closed intestinal loops.

Davis and Stone,¹⁸ in 1917, publish the result of work showing that the toxins that produce the same symptoms and the same lesions of the intestine as do the toxins derived from an obstructed loop, may be elaborated from the intestinal secretion *in vitro*. They collected first the washings of an isolated loop over a water bath, at a temperature of 90° to 95° C. This was then heated to this temperature for one-half hour on the two succeeding days; when injected it did not produce symptoms or a change in blood-pressure. The unheated secretion was non-toxic, as was that kept under toluene and chloroform. The unheated loop washings were collected in a sterile flask, and kept as well as possible from contamination at 37° C. for eighteen hours; these showed a profuse bacterial growth, and upon injection after filtration through a Berkefeld filter, this caused death with a typical picture in six hours. They do not say positively that the bacteria are responsible, but they do claim to have ruled out enzyme action and the perverted cell theory.

Whipple,¹⁹ in 1919, in summing up the results of the work done by him and his associates, states that nothing produced within the intestinal tract can be directly concerned in the intoxication of intestinal obstruction. The intestinal epithelium is impervious to all toxic substances which can be demonstrated in any amount in the material accumulating in the obstructed intestine. Material obtained from the unobstructed intestine can be fed in unlimited amount, injected into the duodenum, or into the closed loop, without causing the slightest degree of intoxication. He believes that the toxic substance or substances can be formed only by the epithelium of the mucous membrane of the small intestine under obstruction conditions. This material, absorbed by the blood, causes the characteristic symptoms. The poison is not found in the normal intestine. Closed colon loops are never associated with any definite clinical intoxication referable to the closed loop.

Cannon, Dragstedt and Dragstedt,^{7a} in 1920, endeavored to support the conclusion of Dragstedt, Moorhead and Burcky¹⁹ that bacterial activity plus necrotic tissue is the important factor in the production of the toxin. Their experiments, directed toward the changing of the bacterial flora of the intestine, do not seem, however, to have led to any clear-cut result.

In a critical examination of the work of the above authors, one thing must be constantly borne in mind; they have manifestly not all been dealing with the same type of poison. One group is evidently dealing with a poison which violently attacks the central nervous system, while the other group deals with the toxin which the more recent writers have discussed to the exclusion of the nerve poison. The toxin under discussion does not produce convulsions, etc., but produces symptoms which point to a primary attack upon the gastro-intestinal tract, as evidenced by the vomiting, retching, diarrhoea and tenesmus, with a secondary pronounced effect upon the blood-pressure.

After reviewing the literature upon the origin and method of attack of this toxin, one cannot but be impressed by the number of theories advanced, and the recurrence of these theories in cycles, as it were. The earliest,² and also the latest,^{19, 7a} was that of auto-intoxication arising from the stagnating and putrefying intestinal content. While this was at first only an hypothesis, it early received some experimental support. This experimental work, however, did not go far enough, as the authors were content

to reproduce the condition of ileus, and after the death of the animal, the presence of a dilated proximal loop containing a material which, when injected, caused death, was considered to have solved the problem. This theory has been disproved by many workers and in many ways, the most conclusive proof being that which we will offer of the speed with which the toxin appears in the intestinal content of a perfectly normal animal, after the intravenous injection of the toxin.

The next theory to engage the attention of many workers for a time was that dealing with the action of bacteria under the condition of obstruction; these held that death was the result of a bacteriæmia. This theory was disproved by the finding, in so many cases of ileus, that the heart-blood, peritoneum and organs were sterile.

The third theory deals with the secretions poured into the upper intestine. Better technic has enabled later observers to rule out the pancreas and the biliary apparatus as the source of the toxin, even though we shall show from our experiments that the toxin appears in the intestine of dogs dying from an acute pancreatitis.

The fourth theory ascribed the death to the cerebral anæmia which resulted from the bleeding into the splanchnic area, or, in other words, "shock." This is disproved by the many clinical conditions in which "shock" is observed, yet the symptoms and the physical findings do not resemble ileus, and yet we shall show that the toxin appears in the intestine following the splanchnic congestion which results from portal thrombosis.

The fifth theory, that of death being due to reflex irritation of the sympathetics, is not grounded upon facts produced by experimental work.

The sixth theory advanced is that a disturbed circulation is responsible for changes in the intestinal wall which produce the attending symptoms and death. This is disproved by the fact that intravenous injection causes death with typical symptoms in a normal dog—*i.e.*, without at least any gross mechanical changes in the circulation.

As before stated, all these theories have had or still have their adherents. They individually seem to have a semblance of proof which is often difficult to disprove, because of the extreme complication of the conditions under which one must work. But a careful analysis shows that no one of these theories offers a sufficient explanation of the symptoms and findings.

The seventh theory is that of a perversion of the normal function of the cells of the duodenal mucosa. This idea was first expressed by Braun and Boruttau,³ Draper,^{14, 15, 40} and Whipple, Stone and Bernheim,^{54, 55, 56, 57}. Though this theory has been questioned, it has yet to be actually disproved.

The eighth theory is that dealing with the rapid and extreme dehydration of the tissues. This was first advanced by Hartwell and Hoguet,^{26, 27} and has lately been restated by Bacon, Anslow and Eppler,⁷² and by Stone.⁷³ These last have ingeniously tried to use the fact that in some instances there is a rise in the non-protein blood nitrogen, due, as they state, to the water loss, to support the theory of dehydration death. This theory seems hardly

tenable in view of the fact that death may follow the intravenous injection of the poison before any loss of water has occurred.

This brings us to our own entry into a study of the problem. We were impressed by the extremely close similarity existing between the clinical pictures of acute pancreatitis, ileus and acute fulminating peritonitis. We became convinced that such a similarity could arise from the fact that these clinical entities had a closely related factor as the cause. We do not wish to be misunderstood and have one think that we believe that one single factor may cause either ileus or acute pancreatitis, but we do believe that the toxin that is the cause of death in the one case is identical with, or closely allied chemically to, that which produces death in the others, irrespective of its initial source. We believe that it arises within the cells of the mucosa of the duodenum in ileus, and takes origin in the cells of the pancreas in acute pancreatitis. It is inert in the cells in the normal organ, and when it is excreted into the lumen, under normal conditions, is immediately combined with the content of the intestine, and is innocuous.

In obstruction the condition is changed, and instead of being thrown out into the lumen of the intestine, the major portion is forced into the lymph, and thence into the general circulation; the portion thus excreted is intensely toxic, judging from the toxicity of the relatively small amount that is present in the content of the bowel.

The method of obtaining, and to a certain extent, of purifying the toxin, is a modification employed by Wells and Osborne⁶⁷ in their work with vegetable proteoses. The content and mucosa of the small intestine was collected in approximately 250 c.c. of hot water. This was thoroughly mixed, and strained through gauze and cotton; to the solution was added five times its volume of ninety-five per cent. alcohol. The precipitate was filtered off, and boiled with 100 c.c. of distilled water; after all traces of alcohol had disappeared, one gram of magnesium sulphate was added, and it was allowed to boil for a few minutes. The mixture was filtered, and the filtrate precipitated in five times its volume of ninety-five per cent. alcohol; this was filtered, and the precipitate dried in a desiccator. By this method, we had an easily handled, stable product, and were satisfied that all bacterial action, once the original material had been removed from the intestine, had been eliminated. Before using, the precipitate was dissolved in from twenty-five to fifty c.c. of distilled water, and dialyzed for two hours against distilled water.

At first we used material obtained from a series of closed loops. When engaged upon another problem in which complete adrenalectomy had been performed, we noticed that at autopsy the small intestine presented a picture grossly identical with that of the obstructed intestine. This material, prepared in the routine way, produced exactly the same symptoms as the other, and at death the autopsy findings were the same. We also prepared the material found in the intestine of dogs upon which an Eck fistula had been performed, but because of too small an opening between the veins, clotting

had occurred, and death had resulted from a portal congestion. This product also reproduced the symptoms and the gross pathology of obstruction.

As we have mentioned above, our first method of obtaining the toxin was to make an isolated loop and restore the continuity of the intestine by an end-to-end anastomosis. At death we found that the loop had ruptured, or was greatly distended, and showed an acute congestion. The contents, with the mucosa, were prepared by the technic described, and were injected intravenously. The symptoms of poisoning were violent vomiting, retching, diarrhoea with tenesmus, progressive prostration, and frequently death. We obtained the material from six of these high loop animals, and injected normal animals; of these injected dogs, three died with characteristic symptoms, and the autopsy presented the typical picture of high obstruction. From the intestinal content of these non-operated dogs, killed by intravenous injection of the poison, the toxin was prepared and injected into other normal dogs, with the same result.

To rule out the possibility of a histamine reaction, guinea-pigs were injected with this toxin. As the guinea-pigs did not show any reaction whatever, we considered that histamine played no part in the production of the symptoms and death.

Fourteen adrenalectomies were performed. In a few of these cases the duct of Santorini was ligated, and a cannula was tied into the duct of Wirsung, which drained into a rubber bag, in an effort to obtain the pancreatic secretion separate from that of the intestine. Toxin was obtained from both series alike, regardless of the drainage of the pancreas. Upon injecting this toxin the following striking results were noted; the dogs died in a short space of time with the usual symptoms characteristic of the toxin of high obstruction. One dog varied from the usual course in that it lived for three days following the injection; the autopsy in this case showed areas of liver necrosis, the stomach contained several patches of hemorrhage, the intestines were intensely congested and hemorrhagic throughout the entire length. A third dog, in which death had occurred within the usual time, presented a marked pathology; there was free blood in the peritoneal cavity, apparently from a rupture of what looked to be varices beneath the capsule of the liver; the gall-bladder was intensely oedematous, the walls being one-fourth of an inch thick; the pancreas was oedematous in that portion lying along the intestinal wall; the liver lobules were clearly marked; there was blood in the lower small intestine, and congestion of the upper end of the duodenum; the valvulae conniventes of the large bowel showed hemorrhages. In one dog after the adrenalectomy with pancreatic fistula, death followed the usual symptom-complex; the autopsy, however, presented a different picture; the bag had slipped off the cannula, allowing the pancreatic secretion to escape into the peritoneum, and we found as a result a general peritonitis with free bloody fluid, fat necrosis in the omentum and along the gut in the neighborhood of the pancreas; there were areas of necrosis in the liver; in the antrum of the stomach there was a clean-cut ulcer; there was an acute pancreatitis; the intestinal mucosa was congested and hemorrhagic. Material obtained from the intestine of this dog gave a highly toxic preparation.

We next took the content of the intestine of a dog that had died from the intestinal form of distemper. The material obtained caused, upon injection, the immediate death of the animal. The content of this intestine was removed and

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prepared as soon as death had occurred; injection of this material caused death with the symptoms and gross pathology resembling high obstruction. The material from this animal upon injection caused such a violent reaction that we decided to kill the animal. The autopsy showed considerable areas of necrosis of the gastric mucosa, necrosis of the liver, and a typical intestinal picture. The preparation from this dog, though it caused a marked reaction, did not kill. We have in this series carried the toxin through four dogs, causing the death of three with typical symptoms and characteristic autopsy findings; in the fourth animal, though the symptoms were present, the dog recovered.

We next decided to see whether the intestinal contents of dogs dead from acute, non-bacterial peritonitis, contained a toxin. Under strict aseptic conditions, the pancreas was removed from one dog and dropped into the peritoneal cavity of a second dog. This is known to produce a condition of acute pancreatitis with acute, fulminating peritonitis, but in which the bacterial element, which has been such a disturbing factor in the entire history of the study of this problem, could be ruled out. Autopsy following the death of the animal showed an acute peritonitis of an extreme grade; the intestinal content was prepared and injected into a normal dog. This caused the usual symptoms and death, and autopsy showed the usual pathological picture.

The next part of the problem was to determine the state of the normal content. The content was taken immediately following the death of five dogs, killed by ether or by hemorrhage, and prepared in the routine manner. These preparations, when injected into normal dogs, gave only a very doubtful reaction, *i.e.*, defecation.

The next factor to be considered was the rôle played by autolysis; the intestine of a dog killed by ether was allowed to stand at room temperature for seven hours; at the end of this time the content and the mucosa was removed and treated in the routine way. Injection caused a very mild reaction. The intestines of four dogs were allowed to stand at room temperature, in the one case four hours, in the other three cases five hours. A preparation of the content in the first case did not produce the reaction, in the other three cases it caused death. In these cases the bacterial content of the intestine was not interfered with. As a control the intestines of three dogs killed by ether were washed out with water and allowed to stand at room temperature for five hours; the content was then prepared, and injected into a normal dog. This did not produce a reaction. Next the intestines of four dogs killed by ether, were washed out and filled with chloroform, and allowed to stand at room temperature for five hours; the content and mucosa was then removed, the chloroform driven off, and the material prepared in the routine manner. Upon injection of the entire product into one dog, no reaction occurred. We then took the intestines of four dogs killed by ether, and after washing out the content, filled them with water and allowed them to remain at room temperature for five hours; the content in these intestines was noticeably greater than in the cases where chloroform was used. The content of these four together, prepared in the usual manner, and injected into a normal dog, did not produce any reaction. These results, when taken with the results reported by Davis and Stone,¹⁸ raise the question of whether the normal intestinal content, in the presence of the normal bacterial content of the intestine, may possibly give rise to the toxin on standing. This problem reminds one of work which has been done on the activation of the pancreatic juice by bacteria; if, as some have maintained, pancreatic juice can be activated by bacteria, then it would be necessary to admit that the proteolytic ferment of the intestine itself could likewise be activated by bacteria. Nevertheless, in view of the above experiments in which the toxin appears so rapidly in the lumen of the intestine after intravenous injection, we do not believe that bacteria have an exclusive rôle in the production; indeed, we believe that we must conclude that they are not even necessary to its production.

We next determined to try the effect upon the toxin of erepsin, a ferment found chiefly in the lower portion of the small intestine. The erepsin used was obtained from Parke, Davis and Co. Three grams of the erepsin were extracted with fifty c.c. of water for two and one-half hours of body temperature. The mixture was then centrifuged, and the supernatant fluid used for injection. Four such preparations were made and injected into four dogs; only one of these animals showed a slight reaction. Four toxin preparations were combined, and one-quarter of this product was injected into each of two dogs; both died. The remainder was divided into two equal portions; to each was added 0.25 gram of erepsin, and they were incubated for two and one-half hours at body temperature. Two dogs were injected; in the one case the symptoms preceding death were more violent than in the two control dogs; in the other there was no apparent change in the picture. At autopsy the first dog showed a perforated duodenal ulcer, free blood in the peritoneal cavity, marked œdema of the gall-bladder and pancreas, while the autopsy in the second dog did not deviate from the usual picture. Of nine other dogs, injected with this toxin-erepsin preparation, made as above, there were three deaths, five gave a marked reaction, and one did not respond. To summarize this portion of our work, we find that the toxin-erepsin combination caused five deaths, five were profoundly affected, and one was only slightly affected. These results discredit the theory that the lower intestine exerts a detoxifying action. They also tend to show that the toxin is neither a proteose nor a hetero-proteose, since both are digested by the tryptic and ereptic ferments.^{89a, 70}

Our next efforts were directed toward the action of repeated sublethal injections, increasing in amount, to determine whether they would produce an immunity, or whether they would cause a picture of chronic intoxication with ulcer formation. A dog was given 0.75 g. of toxin, to which he reacted violently; after one week the dog received 1.0 g. of the toxin; this did not produce a reaction. A week later, two grams of the toxin were injected; there was no immediate reaction, but the dog died the following day. The autopsy showed the following picture; the duodenum and upper jejunum showed slight indication of the usual involvement; the areas of submucous hemorrhage increased to the terminal ileum, which showed a considerable involvement; the ileocæcal valve was hemorrhagic throughout its entire area; the cæcum was hemorrhagic, and had one area of ulceration; the large bowel contained old and new areas of submucous hemorrhages. A second animal which had received a sublethal dose was promptly killed by a second injection; the autopsy showed the usual picture. This shows that the production of an immunity is very dubious, as one would expect, since we are dealing with a product of the body itself.

As the changes in the intestine in passive congestion resemble grossly those in an obstruction, we took the material from the intestines of dogs upon which an Eck fistula had been done, but had failed because of the small size of the opening between the veins, and prepared it in the usual manner. Two dogs were injected with these preparations; one died with the usual symptoms, and the autopsy showed a typical picture; the other, though it was profoundly affected, recovered. A third preparation of this sort was used in the study of the lymph flow, and gave every evidence of being active.

We injected two rabbits with this toxin and obtained a reaction in each case; therefore the toxin is not specific for species, as has been found by many previous observers, working with toxins prepared by different methods.

We now proceeded to make a more detailed study of the action of the toxin on an animal. A dog was etherized and the abdomen opened; the pylorus was ligated and a cannula placed in the stomach; the intestine was ligated at the duodeno-jejunal junction, and a cannula inserted above the ligature; a cannula was tied

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in the common duct; the duct of Santorini was ligated and a cannula was tied in the duct of Wirsung; a cannula was tied in the carotid and one inserted into the trachea; these last were connected with recording points on a kymograph. The ordinary appearing duodenal content filled the respective cannula; after the injection of toxin, this fluid became blood stained. The dog died; the autopsy showed the usual picture in the duodenum, down to the insertion of the cannula; beyond this point the intestine appeared normal. The contents of the stomach, of the duodenum, and of the small intestine below the ligature, were separately removed, and prepared separately in the usual manner. On injection, the stomach content produced no reaction, while that of the duodenum and of the small intestine were intensely toxic. This experiment was repeated with exactly the same result. In each case the injection of the toxin produced an abrupt fall of blood-pressure, then a gradual rise, followed by a gradual decline, until death occurred. There was no evidence of stimulation of bile flow, nor of pancreatic secretion. These experiments were instructive in that they showed the extreme rapidity with which the toxin appears in the intestinal content following injection, and in the fact that it appeared above and below the duodeno-jejunal ligature, and that it was present below the ligature even though the mucosa of this portion of the intestine showed neither hemorrhage nor even congestion.

We prepared secretion from the intestine of normal dogs. We then anesthetized a dog and tied a cannula in the thoracic duct. The lymph was normal in appearance, and clotted rapidly. We then injected a lethal dose of toxin; the lymph became thin, blood stained, and lost its clotting power to some extent; we then injected four c.c. of secretin, and the lymph rapidly returned to normal. The dog was killed and the autopsy showed a hemorrhagic infiltration of the intestine, but not as extensive as usually noted. Another dog was prepared in the same manner, and the lymph collected; after the injection of the lethal dose, the characteristic changes in the lymph appeared. In this case we did not administer secretin, and the dog died in the course of a few hours; the autopsy showed areas of hemorrhagic infiltration of the intestine more extensive than in the first case. In neither experiment was a lymphagocytic action of the toxin exhibited, which fact also tends to disprove the theory that the toxin is either a proteose or a hetero-proteose.^{9, 10}

In all our work with the toxin we were greatly impressed with the rapidity with which the toxic element was excreted into the lumen of the intestine. This was shown time and again where the dogs died almost immediately after receiving a lethal dose of toxin. Autopsy was performed as soon as death occurred, and we obtained from the content sufficient toxin to kill. We feel that a justification of Sweet's criticism of Whipple's work, that the finding of the toxin in the isolated loop does not necessarily mean that it is formed there, but that it might be formed in the functionally obstructed loop, is found in the experiments in which we had ligated the intestine at the duodeno-jejunal junction, injected toxin, and were subsequently able to demonstrate toxin in both the afferent and efferent loops. These experiments also show that the toxin circulating in the blood-stream can apparently excite the cells of the intestinal mucosa to the formation of the poison, for if one considers the small amount of the toxin solution injected, and the large amount of dilution that must occur in the blood-stream and in the tissues, and the loss incident to the necessarily crude method used in recovering the

toxic element from the intestinal content, then one must conclude that it is not possible that we are dealing with the recovery of the original dose. Our experiments with the adrenalectomy and the Eck fistula dogs seem to correlate the theories dealing with disturbance of the circulation, distention and nervous irritation, and show that under such conditions a toxin can be formed; but that these conditions are not necessarily causative conditions for the formation of the poison is proven by the finding of the poison under circumstances in which exactly the opposite conditions exist, namely, lack of congestion, hyperperistalsis and extreme contraction of the gut, as was frequently seen in animals dying quickly after intravenous injection of the poison.

Our experiments with the erepsin-toxin combination show that the secretions of the lower small intestine do not exert a detoxifying action, and also that the toxin is neither a protease nor a hetero-protease. The lack of effect upon guinea-pigs proves that the toxin is not histamine.

A review of our work shows that a toxin is produced in high obstruction that is the same, or similar to, the toxin produced in acute pancreatitis, in acute fulminating peritonitis of non-bacterial origin, acute congestion and in paralytic ileus. This toxin may be recovered from the intestinal content, and, to a certain extent, purified. When injected intravenously, it reproduces the clinical picture of obstruction, that is, vomiting, retching, diarrhoea, tenesmus and prostration, with a subnormal temperature and a fall of blood-pressure. The autopsy findings are characteristic, and consist of more or less congestion of the mucosa of the stomach; intense congestion of the mucosa of the small intestine with hemorrhage, giving to the mucosa the appearance of purple velvet. We have occasionally found gastric ulcers, once a perforated duodenal ulcer, and once an ulcer of the cæcum. This raises the question whether the underlying cause of ulcer formation may bear some relation to this toxin. We have sometimes seen œdema of the gall-bladder and pancreas. We believe that we are justified in stating that the normal intestinal content does not contain this toxin, nor does the secretion of the lower intestine have any detoxifying properties. There is nothing in the reaction of the toxin that would lead one to believe it identical with histamine.

The results of our many and diverse lines of experimentation seem to be important in two ways; first, that they correlate and explain some of the different opinions advanced by other workers; second, they confirm the view that the site of origin is the cells of the intestinal mucosa. In considering the first point, the finding of a poison which is apparently the same as that found in high obstruction, in other conditions, tends to reconcile the contentions of writers like Murphy and Vincent³⁰ that the interference with the blood supply is an essential factor in the production of the toxin with their opponents; since we find it in the condition of complete portal obstruction, one must conclude that the toxin can be formed under conditions of interference with the circulation. This may also explain

the old clinical observation that a case of volvulus often runs a more severe course than does simple obstruction. On the other hand, the finding of a toxin after the removal of the adrenals, after portal congestion, and within such a short time after the intravenous injection of a fatal dose of the poison, does seem to us to rule out any essential rôle of the bacteria of the intestine; for it is inconceivable that the intravenous injection of poison, or that portal thrombosis, both of which are fatal in from a few minutes to a few hours, should in any way favor the action of the intestinal bacteria. Likewise, it is difficult to understand how adrenalectomy could change the conditions of bacterial life within the intestine.

If, as we believe, we are dealing with a disturbance of the proteolytic enzyme of the mucosa comparable entirely to the conditions existing in acute pancreatitis, in which the toxic agent is undoubtedly the tryptic ferment of the pancreas, then we can readily understand why the changes in diet could modify the final picture, as has been reported by Magnus-Alsleben,⁴¹ Roger and Garnier,^{47, 48, 49, 50} and lately by Dragstedt.^{7a} We might say further that it is shown by our experiments that an injury to the mucosa or the entire wall of the intestine, which has been considered by some authors as an essential factor, is certainly not necessary.

The reason why a clinical differential diagnosis between acute pancreatitis and acute high obstruction is so difficult if not impossible, becomes clear as a result of our work; if we are correct in our assumption that the toxic element is the proteolytic ferment of the cells of the mucosa, then the two conditions are based upon a factor which is essentially the same in both instances. We therefore must expect that the general symptoms would be, as they are, precisely the same. A differential diagnosis could therefore, of necessity, be based only upon a careful study of the history of the case, such as a history of gall-stones, accidental injury to the abdomen which might have involved the pancreas, and local symptoms referable to the pancreas itself.

The finding of the same poison in the intestinal content of an animal killed by dropping into the peritoneal cavity the sterile pancreas of another dog, suggests that the two conditions may be even more closely related than a mere relationship of the toxins involved; in other words, the condition of pancreatitis may favor the production of the intestinal poison, just as does the intravenous injection of the poison itself. In this event, the two would be clinically alike because they are etiologically one and the same thing.

The explanation of the finding of the toxin after the removal of the adrenals is very difficult. It surely cannot be ascribed to a disturbance of the circulation of the intestine, as autopsy fails to reveal any such disturbance. It is possible that an, as yet unknown, control is exercised by the adrenals over the glands of the gastro-intestinal tract. Such a relationship was observed by Sweet and Pemberton;⁶⁸ these workers found that

after the removal of the adrenals, the pancreas began to secrete, the secretion becoming more and more pronounced up to the death of the animal.

The results of our experiments with secretin, while still incomplete, suggest the possibility that the course of the flow of the perverted secretion may be markedly influenced, that is, that by injecting secretin, we may produce a greater secretion of toxin into the lumen of the intestine, and consequently a lessened secretion into the lymph stream. The attempts at immunization have not offered any promise, neither in our hands nor in the reports of others in the literature. This failure of the immunization experiment might be considered to support our conclusion that we are dealing with a perverted normal product of the body, a product, which, being ordinarily normal, but under these peculiar conditions perverted, would naturally not be able to produce an immunity. At the same time, the hope that some means of defense may be found is supported by the experience which we have frequently had, and which is supported by the observations of others, that different animals of the same species react so differently to this toxin. In many instances we have observed that of two animals injected with the same dose of toxin, one would react violently and death would occur in a short time, while the other would show only a very mild and transitory reaction. Such a result can only be explained on the basis either that the second animal possessed some natural property of resistance to the toxin, or that the intravenous injection of the toxin creates some condition in the first animal that favors the production of the poison. These conditions may be subject to physiological variations; such a variation might well be produced by the character of the diet, or by the physiological condition of the animal, as in Kirstein's experiments upon the hibernating animal. We at one time believed that there was a relationship existing between the stage of digestion and the susceptibility to the toxin; but on comparing the results of experiments made upon animals recently fed with experiments on fasting animals, we were unable to arrive at any definite conclusions.

As the result of our observations we have arrived at the following conclusions:

1. That from the intestinal content in cases of high obstruction, a poison can be isolated by precipitation with alcohol, extraction with boiling water and reprecipitation with the aid of magnesium sulphate.
2. That it is not possible to obtain such a poison with this method from the intestinal content of a normal dog prepared immediately after removal.
3. That a poison which, when judged by the means at our disposal, is identical, can be obtained from conditions other than actual obstruction, such as the intravenous injection of the high obstruction toxin into normal animals, the removal of the adrenals, portal obstruction, and in experimental, acute, fulminating, non-bacterial peritonitis.
4. That this poison is undoubtedly elaborated in the cells of the greater

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part of the mucosa of the small intestine, but chiefly in those of the duodenum, and that it is manifestly excreted, partly into the lumen of the intestine, but the larger part passes into the lymph stream.

5. That the clinical similarities between acute pancreatitis and high obstruction are due either to a close relationship between the toxins involved, or possibly to the fact that acute pancreatitis actually produces conditions in the intestinal mucosa favorable to the production of the same toxin as is found in cases of high obstruction.

6. Since erepsin fails to exert any action upon the toxin, and since the toxin shows no lymphagogenic action whatever, it seems necessary to conclude that the toxin is neither a proteose nor a hereto-proteose.

7. That the clinical advantage of gastric lavage may be explained by the removal of the toxic content and the favoring thereby of an increased excretion into the lumen of the intestine. In addition to this treatment, should be added the introduction of large amounts of saline, both intravenously and by the rectum, to further the excretion of the toxin both by the bowel and by the kidneys.

8. That the finding of the toxin in the intestinal content after the removal of the adrenals suggests that clinically adrenalin should be added to the saline infusion in sufficient amount so that a continuous supply of adrenalin is being furnished.

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THE PRESENT STATUS OF EPIPOPEXY*

WITH THE REPORT OF TEN CASES

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THE surgical measures employed for the relief of cirrhosis of the liver have been various, but all directed at the diversion to the systemic circulation of a part of the venous blood going to this organ and carrying poisonous products, which the liver should normally eliminate. The idea of bringing relief to the liver by this diversion of the venous blood was conceived, like so many new ideas in medicine, independently and at about the same time by several men. The surgical procedure first suggested and practised consisted in irritating by gauze friction the upper surfaces of the liver and spleen and the under surface of the diaphragm, and the fixation of the omentum to or in the abdominal wall. Talma, of Utrecht, suggested this operation in 1889 and the first three operations were done by Dutch surgeons, von der Meule (1889), Schelkly (1891), and Lens (1892). The last patient survived the operation six months, the first two died shortly after operation.¹ Rutherford Morison, of New Castle, at the suggestion of Drummond, who knew nothing of Talma's suggestion or of the work of the Dutch surgeons across the channel, performed the first successful operation in 1894 and 1895. These cases were reported in 1896.² Talma's first paper appeared in 1898.³

Owing to the publications of these three men the operation has been designated by subsequent writers as the "Talma," or the "Talma-Morison," or the "Talma-Morison-Drummond" operation, though they called it omentopexy or epiploexy, as the fixation of the omentum was considered the important step in the procedure. It is with the present status of this operation that we will deal, but it is well first to consider briefly the other surgical means suggested or practised for the relief of hepatic cirrhosis.

The idea of anastomosing the portal vein and the vena cava, the establishment of the so-called "Eck's fistula," would at first sight seem a rational one, provided of course the operation carried with it little risk; but notwithstanding the accomplishment of such a fistula by Vidal and several other surgeons,⁴ the operation has proved too dangerous a one and no patients have survived long enough to enable us to form any opinion as to its effect on the overburdened liver.

The ligation of some of the main tributaries of the portal vein has been done. Mayo⁵ speaks of the ligation of the inferior mesenteric or superior rectal vessels as a supplement to epiploexy and Moynihan⁶ mentions ligation of the inferior mesenteric vein as an additional means of diverting blood from

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the portal circulation. Ligation of the splenic artery with the object of producing atrophy of the spleen has been suggested by J. Gerster and Hartmann and others have reported cases, but the mortality has been large (Moynihan).

Anastomosis of the superior mesenteric and spermatic or ovarian veins, although accomplished many times, has not been successful.

Transplantation of the testicle and the spermatic cord to the abdomen and surrounding it with the omentum was recommended and practised by Lanz, 1911, and Lorenz reported two cases well two years after the performance of this operation.

All kinds of drainage of the ascitic fluid have been tried. Repeated aspirations have cured some cases, probably due to the resulting adhesions. External drainage, notwithstanding its advocacy by so excellent a surgeon as Rutherford Morison, has not appealed to most surgeons, because of the danger of infection of the peritoneum. Our own plan has been always to take pains to prevent leakage of the fluid after operation. Subcutaneous drainage of the fluid by means of the implantation of silk threads (Lambotte), sections of blood-vessels, glass and rubber tubes, has not been successful after extensive trial. Handley has employed the femoral canal for subcutaneous drainage, but excepting one "brilliant result," the operation has proved unsatisfactory, as the new canal connecting the peritoneum and the connective tissue of the thigh becomes obliterated (Binnie). Route, in 1907, first tried anastomosing the saphenous vein with the peritoneum and the operation seemed to offer some chance of successful drainage of the ascitic fluid, but subsequent reports by several surgeons go to show that the drainage is only temporary, as the vein becomes occluded or obliterated.⁷

In 1891 Terrier performed cholecystostomy and maintained the biliary fistula, urging its use for the cure of cirrhosis, on the ground that this condition resulted from infection from the intestinal tract through the bile ducts. This operation was later popularized in France, largely by the publication of many successes by Delangeni re. Greenough,⁸ in 1902, collected seventeen cases, nearly all French, of which thirteen were relieved. This operation, however, does not seem to have been given much attention by American or English surgeons. Cholecystenterostomy has also been done in a number of cases. It would seem that both cholecystostomy and cholecystenterostomy could only relieve those cases of cirrhosis due to infection through the bile ducts and gall-bladder.

Direct drainage of the liver by puncture through the abdominal wall, done with the idea of relieving the engorged liver, is not an operation which appeals to surgeons.

A number of successes have apparently followed visceropexy and a few the simple opening and closing of the abdomen, as is done in the moist type of tuberculous peritonitis. Any successes following these measures must be due to the resulting adhesions and tend to confirm the reasoning of Talma and Morison.

Splenectomy, where an enlarged spleen accompanies hepatic cirrhosis, is recommended very strongly by W. J. Mayo. He has done this operation in six cases and five were greatly relieved. In splenic anæmia he has found cirrhosis of the liver in a considerable number of cases and here the splenectomy seemed to cure the cirrhosis. Splenic enlargement in cirrhosis of the liver with ascites does not seem to have been a common condition, but should it be found, splenectomy would seem to be indicated, in view of Mayo's results. Certainly the removal of the spleen cuts down to an enormous degree the blood passing to the portal vein and both Mayo and Moynihan refer to the poisons carried from the spleen to the liver by the venous channels and these of course are eliminated by splenectomy.

Epiplopexy.—Since the early publications of Morison and Talma, many contributions to this subject have been made from many countries and various modifications of the original technic have been suggested. Among the early notable papers in this country was one by Packard and Le Conte (*Amer. Jour. Med. Sciences*, 1901), including the report of two cases: another by Greenough (*Amer. Jour. Med. Sciences*, 1902), who presents a summary of 105 cases collected from the literature. The mortality within thirty days in these cases was twenty-nine and one-half per cent., and there was improvement in forty-two per cent. M. L. Harris⁹ analyzed the reported cases and several of his own and took a rather pessimistic view of the results obtained. He did not agree with the reasoning of Talma, but believed that chronic inflammatory changes in the peritoneum were influential in the production of ascites. White¹⁰ and other Englishmen hold the same opinion.

Many valuable papers have been presented during the past twenty years and show very different views as to the benefit to be derived from epiplopexy.

Morison¹¹ reports one case well for seven years after operation and another who lived for six years, dying then following an operation for ventral hernia, and a third died two years after operation from pneumonia. W. J. Mayo¹² has performed epiplopexy twenty-eight times. There were four deaths following the operation and eight patients died later. The remaining sixteen patients he reports as relieved. Moynihan has operated seven times, one case being cured, another relieved. The literature contains many reports of one or two cases which have remained well for a number of years after operation. Large collections of cases have been made by Montprofit¹³ in France, by Landenburger¹⁴ in Germany and White¹⁰ in England. Eliot and Colp¹⁵ present a study of twenty-three cases operated upon in the Presbyterian Hospital in New York out of 127 cases of cirrhosis of the liver admitted to the hospital during the previous seventeen years. In eighteen cases the cirrhosis was due to the excessive use of alcohol, two were syphilitic and in two the ascites was associated with an enlarged liver due to cardiovascular disease. One of these last two died directly after operation, but the other is living and greatly relieved three years after operation. There were eight post-operative deaths in the twenty-three cases. The end results were

known in but seven of the remaining fifteen cases and these had all derived benefit from the operation and were living from three months to three years after it. Riesman¹⁶ takes an optimistic view of the condition and urges further use of epiploxy. He says that "cirrhosis of the liver is one of the few chronic non-bacterial visceral diseases, perhaps the only one, that may actually be cured." He states that if the interval between the tappings for ascites is decreasing, tapping should be discontinued and the patient operated upon.

One is struck in reviewing the literature with the fact that some cases are apparently cured, while others, the greater number, are not benefited at all. It was with the hope of trying to arrive at some explanation of this fact that we took up the study of our own cases, ten in number, and compared them with those already reported.

While our results have not been strikingly good, they have been good enough to make us feel that the operation of epiploxy is a useful one and one which we can expect to result in cure in probably ten per cent. of the cases and in benefit to a much larger percentage.

W. J. Mayo puts the cirrhoses of the liver into two main groups, one he calls "portal cirrhosis," and the other "biliary cirrhosis." (1) "Portal cirrhosis, in which the irritants, bacterial, toxic, and biochemical substances are received from the intestinal tract and from the spleen by the way of the portal vein, and in which the connective tissue is deposited about the radicles of the portal vein. (2) Biliary cirrhosis, in which the infectious agents reach the biliary ducts by extension of infections from the gall-bladder, and great bile ducts, or from hæmatogenous infections commonly portal or, not rarely systemic, such as those following pneumonia, typhoid, focal lesions, etc., and in which the connective tissue deposit is related to the biliary ducts. The many varieties of cirrhosis described are to be looked on as variations and combinations of these two main divisions."

"Portal cirrhosis when advanced gives rise to the clinical symptoms which depend on portal circulatory obstructions shown by ascites and gastric hemorrhages. Jaundice is absent or a terminal condition. Local areas of portal cirrhosis are not infrequent and often without symptoms."

"Biliary cirrhosis, on the contrary, depends on infections in the biliary ducts, and if the whole or greater part of the liver is involved, jaundice is an early, prominent and continuous feature. Ascites is absent or a terminal manifestation. It would appear that we ordinarily recognize as biliary cirrhosis only the late stages of a relatively frequent liver condition after more or less permanent and extensive damage to the liver tissues has taken place. Infections of the gall-bladder and biliary tract are often accompanied by localized cirrhotic processes without definite symptoms."

Whether or not one accepts this classification, it is well to bear in mind the different sources from which cirrhosis may come, and we think it explains to some extent some of the successes and failures of the different operations. For instance in the "portal" type, biliary drainage, except as

the operation produces adhesions, could be expected to do little good, and in the "biliary" type epiplopexy could hardly produce a cure.

It seems quite evident that the alcoholic cases are the ones giving the best results and the syphilitic the worst. Morison says that we should be able to cure by epiplopexy every case of alcoholic cirrhosis. The majority of our own cases were not alcoholics. He thinks that no syphilitic case is cured by the operation. One of our syphilitic cases, who has survived the operation five and one-half years, has still to be tapped at regular intervals.

Greenough, from the study of his collection of cases, concluded that the hypertrophic type gave better results than the atrophic, and White and Eliot's collections tend to confirm this fact. In all of our ten cases the liver was contracted and in but one was enlargement of the spleen noted. The results in the cases operated upon early in the disease have been better than where the operation was postponed for a long time. Eliot reports a case, however, of marked cardiovascular disease which was benefited and one of our cases presented the same condition. The cases in which ascites is of slow development give better results than those in which it takes place rapidly.

The association of tuberculous peritonitis and cirrhosis of the liver is an interesting one and probably explains to some extent the difference in opinion as to the source of the ascites. Hertzler¹⁷ states that cirrhosis of the liver occurs in about twelve per cent. of the cases of tuberculous peritonitis. In one of our cases I found the omentum rolled up and fixed and was unable to do anything but open and close the abdomen. This patient was tapped eighteen times before operation, and of course the condition found may have been due to the previous tapplings. He is living, nearly a year after operation, and has been tapped once since. I think it is quite possible that this is a case of tuberculous peritonitis.

Operative Technic.—Since there seems to be no doubt that extensive adhesions produce the desired results and that too extensive operative procedures are the cause of a rather high mortality, it would appear that we should make the operation as short and simple as possible. Our own experience has taught us to eliminate elaborate technic and prolonged anæsthesia, and therefore in our recent cases we have simply fixed the omentum to the parietal peritoneum by two rows of mattress sutures passed through the recti about two inches to either side of the midline, the skin being reflected to permit the necessary exposure of the muscles. This requires but a very few minutes. We have used ether, chlorid of ethyl, gas-oxygen and infiltration anæsthesia, all preceded by morphia, and we believe that the gas-oxygen is probably the best.

Our operative mortality was two out of the ten cases, one died of pneumonia forty-eight hours after operation and the second four days after operation from peritonitis. These deaths occurred when we were following the more elaborate procedure. In the last six cases there has been but one death with which the operation might be associated. This patient died two months after operation; she was a syphilitic.

Two modifications of the Morison technic have been extensively employed. Schiassi placed the omentum between the peritoneum and the abdominal muscles, and Narath brought it out between the recti muscles and fixed it under the skin.

Although these operations apparently have given good results, I think that both add to the operative risk. The same may be said of Morison's method in which drainage of the pelvis by a glass tube is employed. Of course this would seem also to increase the risk of subsequent infection. We think that most operators have eliminated friction of the liver, spleen and diaphragm because they believe it is productive of shock. In Greenough's collection of cases, the Talma-Morison operation was accompanied by a mortality of thirty-two per cent. and the Schiassi operation by only seventeen per cent. It must be remembered, however, that in the Talma-Morison cases, friction of the viscera and drainage of the pelvis were probably employed.

We have had no experience with ligation of the mesenteric veins, as an additional means of cutting off the supply of portal blood. It must be remembered that in the majority of cured cases, aspirations of the fluid subsequent to operation have been necessary. The reaccumulation of fluid does not mean that the operation is a failure unless it is persistent.

The following is a summary of our ten cases, all of which have been followed:

One case died forty-eight hours after operation from lobar pneumonia (Case III).

One case died four days after operation from peritonitis; operation under infiltration anæsthesia followed by wound infection (Case IV).

One case died two months after operation, apparently from toxæmia (Case VII).

One case died about three months (?) after operation at another hospital; cause of death unknown (Case I).

One case relieved of all symptoms for three years, then died of apoplexy (Case II).

One patient relieved of symptoms for eighteen months and able to work, then had several profuse gastric hemorrhages, which were controlled under rest, and the patient discharged from the hospital in good condition. No ascites. Died four years after operation; cause of death unknown (Case V).

One case is alive eighteen months after operation and in good health; has gained twenty-five pounds in weight. No evidence of a reaccumulation of fluid (Case VIII).

One patient is alive six months after operation and able to do light work. No reaccumulation of fluid since discharge from hospital (Case X).

One case, a syphilitic, is alive five years after operation with no relief of symptoms (Case VI).

SYNOPSIS OF CASES

CASE I.—Pennsylvania Hospital, No. 1416; operation, September 6, 1910. S. C., white, female, aged forty-seven years; no alcoholic or syphilitic history.

No jaundice, no marked dilatation of superficial veins of abdominal wall, no gastric symptoms, no history of hemorrhage. Edema of lower extremities for four or five months before operation. Urine ex. specific gravity 1030, heavy cloud of albumin. No pre-operative tapplings. Duration of symptoms one year. Operation ten weeks after enlargement of abdomen was first noticed. Morphia-ether anæsthesia. The liver at operation was contracted and hard; the veins of the round ligament were greatly distended; there was no enlargement of the spleen; there were no adhesions present. Omentum attached to the abdominal wall to left of incision, peritoneum separated from the muscles on the right and a large mass of omentum inserted into cavity thus produced, and the upper surface of the liver and the under surface of the diaphragm scrubbed with gauze. Abdomen closed without drainage. Reaccumulation of fluid occurred, and on the third day a small opening was made through the wound for the purpose of drainage. Six weeks after operation abdomen was tapped and 6000 c.c. of fluid removed. Patient left the hospital against advice and died a few months after operation at another hospital.

CASE II.—Jefferson Hospital, B426; operation, July 18, 1911. M. Z., white, female, aged sixty years; no alcoholic or syphilitic history, but history of attacks of pain which seemed like gall-stone colic and often followed by jaundice years ago. Has not suffered from these attacks for the past three or four years. Loss of weight; vomiting at irregular intervals; no hemorrhage; no œdema of extremities; no dilatation of superficial veins of abdomen. Urine ex. sp. gr. 1017, faint trace of albumin. Blood ex. hæmoglobin seventy per cent.; red blood-cells, 5,100,000; white blood-cells, 7600. One pre-operative tapping was done a year after enlargement of abdomen was first noticed. Operation under morphia-chlorid of ethyl-ether anæsthesia. Liver was contracted and nodular throughout. No enlargement of spleen. There were numerous adhesions about the liver; the colon was adherent so that the gall-bladder could not be felt. The omentum was fixed to the parietal peritoneum on the left side and a considerable portion of the omentum fixed in a pocket made by dissecting up the peritoneum on the right side. Abdomen closed without drainage. There was a post-operative reaccumulation of fluid which disappeared without tapping. Patient discharged from hospital one month after operation and was relieved of symptoms for two years; then died of apoplexy. She never suffered a recurrence of ascites.

CASE III.—Pennsylvania Hospital, No. 1941; operation, October 22, 1913. A. T., white, male, aged sixty-one years, moderate drinker of beer, Wassermann negative, duration of symptoms eight weeks. At the onset of illness abdomen painful, had a chill, some vomiting and was slightly jaundiced. No dilatation of superficial veins of abdominal wall; no œdema of lower extremities; no hemorrhage. Urine ex. sp. gr. 1030, trace of albumin; few leucocytes and hyaline casts. Leucocyte count 6900. First tapping about three weeks after onset of symptoms, 5715 c.c. of fluid removed. There were four pre-operative tapplings and between five and six thousand c.c. of fluid removed each time. Operation under morphia-chlorid of ethyl-ether anæsthesia. Liver was contracted to about one-fourth its normal size and the veins of the omentum were enlarged. No enlargement of the spleen. No adhesions. The omentum was split and the two halves crossed and each inserted into a pocket on either side of the wound made by dissecting up the peritoneum. Abdomen closed without drainage. Death forty-eight hours after operation from lobar pneumonia.

CASE IV.—Pennsylvania Hospital, No. 2699; operation, November 12, 1913. D. D. G., white, male, aged forty years, used alcoholic beverages to excess. chancre at seventeen years (Wassermann not recorded). History of attack of pain in right hypochondriac region, necessitating morphia, two years previous. Second attack similar in character, but on left side, six months later. No jaun-

dice. During present illness slight loss of weight; discomfort in epigastrium; œdema of legs; hemorrhoids; no dilatation of the superficial veins of abdomen. Urine ex. sp. gr. 1016, faint trace of albumin, few granular casts. No pre-operative tappings. Operation four weeks after enlargement of abdomen was first noticed under infiltration anæsthesia. Liver contracted and hard; no enlargement of spleen; no adhesions. The omentum was divided, the two halves crossed and each inserted into a subperitoneal pocket. Death four days after operation from peritonitis.

CASE V.—Jefferson Hospital, D4726; operation, February 28, 1914. A. M., white, male, aged fifty-two years, heavy drinker of beer, no history of syphilis. Duration of symptoms about one year. Epigastric pain, worse during day, not influenced by the taking of food. Bowels irregular. Has had several profuse gastric hemorrhages, is pale and has lost between twenty and thirty pounds in weight in the past year. Sclera icteroid; no dilatation of superficial veins of abdomen; no œdema of extremities; no free fluid demonstrable before operation. Urine examination negative. Fæces negative for occult blood. Blood examination, hæmoglobin seventy-two per cent.; red blood-cells, 4,120,000; white blood-cells, 8800. It was a question whether this patient had a cirrhosis of the liver or a malignant growth. Operation under morphia-chlorid of ethyl-ether anæsthesia. Liver found contracted and irregular, considerable free fluid, no enlargement of spleen, no adhesions. Omentum attached to abdominal wall by three mattress sutures on each side of the incision and wound closed. Post-operative course uneventful. Discharged from hospital five weeks after operation. Patient well of symptoms and working for eighteen months, then several profuse gastric hemorrhages, controlled by rest, and the patient discharged from the hospital in good condition. No ascites. Died four years after operation; cause of death unknown.

CASE VI.—Bryn Mawr Hospital; operation, June 9, 1916. H. M., white, female, aged sixty years, history of intemperate life, Wassermann strongly positive. It was a question whether this patient had a cirrhosis of the liver or a malignant growth of the colon. There was considerable fluid in the abdomen, but the X-rays suggested some obstruction at the hepatic flexure. Operation under morphia-gas-oxygen anæsthesia. There was marked cirrhosis of the liver and an enormous quantity of fluid in the abdomen; no enlargement of the spleen; no adhesions. The omentum was sutured in a pocket between the peritoneum and muscle. Post-operative course uneventful, but there was a reaccumulation of fluid. Five years later patient is alive and able to do light work, but has never been free from ascites. She has had to be tapped at intervals of a few weeks ever since her discharge from the hospital. She now has marked dilatation of the superficial veins of the abdominal wall.

CASE VII.—Pennsylvania Hospital, No. 4280; operation, January 17, 1917. M. I., white, female, aged fifty-three years, no history of alcohol, Wassermann strongly positive. Cough, night sweats and loss of weight for the past year; abdomen noticeably swollen for the past four months. Past few months dyspnœa; nausea at times, but no vomiting; no jaundice, no hemorrhages; no œdema of lower extremities; no dilatation of superficial veins of abdomen. Urine examination, sp. gr. 1020, light cloud of albumin, few hyaline and granular casts. No pre-operative tappings. Operation four months after swelling of abdomen was first noticed under morphia-chlorid of ethyl-ether anæsthesia. Liver rough and contracted; no enlargement of spleen; no adhesions, except about uterus, which contained fibroids. Omentum sutured to incision and abdomen closed. A week after operation there was some bleeding from the wound, controlled by packing. There was a reaccumulation of fluid. Five weeks after operation

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abdomen was tapped and 8200 c.c. of fluid removed. Eight weeks after operation evidence of toxæmia developed, patient became jaundiced and died.

CASE VIII.—Jefferson Hospital, I6316; operation, April 26, 1920. E. O., white, male, aged thirty-three years, no history of the use of alcohol; Wassermann negative. Previous operation four months ago in a New York hospital, apparently for an ascites, six weeks after swelling of abdomen was first noticed. Tapped three times before first operation and about fifteen times between first and second operations. Patient states that he has lost weight; no gastric symptoms; no jaundice; no œdema of lower extremities; no hemorrhage. Superficial veins prominent over entire abdomen. Urine examination, sp. gr. 1024, faint trace of albumin. Blood examination, hæmoglobin eighty-nine per cent., red blood-cells 4,550,000, and white blood-cells 14,000. Operation under morphia-gas-oxygen anæsthesia. Liver contracted and studded with small nodules; no evidence of tuberculosis; no enlargement of spleen; omentum not adherent to old scar, but adherent to parietal peritoneum on the left side. It was fixed about the wound to the parietal peritoneum over an area of about two and one-half by three and one-half inches by stitches passed through the muscle. There were ten post-operative tapplings; the first about two weeks, and the last about three months after operation. Eighteen months after operation patient is in good health; has gained twenty-five pounds in weight and there is no evidence of free fluid in the abdomen.

CASE IX.—Jefferson Hospital, No. J4634; operation, February 15, 1921. J. E., white, male, aged thirty-eight years, no history of alcohol, Wassermann negative. Duration of symptoms eight months; cough, dyspnoea; loss of weight; œdema of lower extremities; no dilatation of superficial veins of abdomen; no jaundice; no hemorrhage. Urine examination, sp. gr. 1025, faint trace of albumin, occasional hyaline casts. Blood examination, hæmoglobin eighty-three per cent.; red blood-cells 4,400,000; white blood-cells 9600. Sputum examination negative for tubercle bacilli (five examinations). First tapping less than two months after patient first noticed swelling of abdomen. Tapped eighteen times before operation. Operation under morphia-gas-oxygen anæsthesia. Liver was contracted and nodular and adherent to the abdominal wall, the only place that it was free being far around on the right lobe. Numerous recent adhesions. Omentum appeared to be rolled up and adherent across the abdomen. Exploration only; abdomen closed. Reaccumulation of fluid after operation, but patient was discharged from hospital three weeks after operation in fair general condition. Eight months after operation family physician writes that patient is living, but that abdomen is still distended. He was tapped once but only a quart of fluid obtained. Present condition is poor.

CASE X.—Pennsylvania Hospital, No. 990; operation, April 27, 1921. N. F., white, male, aged fifty-one years, history of moderate use of beer and wine, Wassermann negative. Duration of symptoms two months; cough; loss of weight; enlargement of abdomen; no jaundice; no œdema of lower extremities; no hemorrhages; no dilatation of superficial veins of abdominal wall. One pre-operative tapping six weeks after swelling of abdomen was first noticed, 1500 c.c. of fluid removed. Operation under morphia-gas-oxygen-ether anæsthesia. Liver contracted and hob-nailed; gall-bladder tense and could not be emptied by pressure; no stones felt; head of the pancreas very hard; spleen enlarged to about three times its normal size; no adhesions. Omentum attached to abdominal wall by four mattress sutures on each side of incision. Post-operative course uneventful. Fluid reaccumulated, necessitating tapping once, this shortly before discharge from the hospital, nineteen days after operation. Patient alive six months after operation and able to do light work. No reaccumulation of fluid since discharge from hospital. Spleen still enlarged. Blood examination,

hæmoglobin eighty per cent.; red blood-cells 3,760,000; white blood-cells 6900.
Red blood-cells normal in size and shape; no degeneration.

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BLEEDING ULCER OF THE DUODENUM ASSOCIATED WITH CHOLECYSTITIS*

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WITHIN the past year I have operated on four patients with bleeding duodenal ulcers in whom the pathologic condition was more extensive in the gall-bladder than in the duodenum. In each case the duodenal ulcer could be demonstrated easily and in one case it was of long standing, as evidenced by the amount of scar tissue. A very severe grade of cholecystitis was also present in all of these cases. The gall-bladders of the four patients were very much alike, being rather larger than normal, with thick, oedematous. They were not compressible, because of the inflammatory deposits in the tissues. They contained stones and infected bile in each instance. I believe that their mucous membranes were completely destroyed and that they were functionless.

These cases of cholecystitis and duodenal ulcer were also very similar clinically. The chief symptom in each case was gastro-intestinal hemorrhage, usually very severe, occurring at intervals of a few months. Two of the patients arrived for treatment just after hemorrhage; one had had a severe hemorrhage on the train the night before. The two patients had a hæmoglobin of about thirty per cent. on first examination. All four patients complained of mild dyspepsia which was easily controlled by regulation of the diet and proper management. The massive hemorrhages occurred when least expected, often when the patients had been symptom-free for a long time. None of the four had ever had severe pain. It was impossible to elicit a history of gall-stone colic or any other symptom suggestive of a disease of the gall-bladder. In one patient, an elderly man who had had very severe hemorrhages at intervals for many years, and who had a great deal of scar tissue in the wall of the duodenum, the lumen had been greatly reduced. Following a gastro-enterostomy some years previously, he had been relieved for a time, but the attacks of hemorrhage returned. A severe hemorrhage occurred just before his arrival at the Clinic, and operation was postponed for several weeks in order to allow him to recover. He had marked arteriosclerosis which may have accounted for the apparent ease of the bleeding. Four weeks later when the operation was performed there was no evidence of a break in the mucous membrane of the duodenum or of vessel erosion as possible sources of bleeding. There was a great deal of scar tissue in the wall of the duodenum, inflammation in the tissues of the gall-bladder, and a definite inflammatory process throughout the liver. Hepatitis had progressed almost to the stage of cirrhosis. There was no jaundice or ascites.

* Read before the Southern Surgical Association, December, 1921.

The findings at operation on the other three patients differed somewhat. There was definite ulceration on the anterior part of the duodenum away from the larger vessels which appeared quite unimportant. There was no induration or deformity of the duodenal lumen. It is possible that there were other and deeper ulcers which were not found, but I believe that these small areas of duodenitis in the region of the duodenal cap were the only lesions in the duodenum. There was extensive hepatitis and cholecystitis, with stones and infected bile in the gall-bladder. While tissue was not removed from the liver for microscopic examination, we nevertheless were convinced that the hepatitis was the type usually seen in association with cholecystitis and that it had not reached the stage of cirrhosis.

The findings in these four patients impressed us with the importance of infections in the gall-bladder as a possible etiologic factor in cases of gastro-intestinal bleeding. A definite lesion in the duodenum was found in every instance and undoubtedly was the point from which bleeding occurred. The hemorrhages were of the massive type, such as usually occur from the pancreaticoduodenal artery, and yet in each case it was quite definitely shown that none of the larger vessels could be involved in the ulcerations.

There is sufficient evidence to show that gastro-intestinal bleeding may occur as a result of infection in the gall-bladder and liver. Balfour mentions a case in which bleeding ceased after the removal of a chronically inflamed gall-bladder. Deaver reports profuse bleeding in hemorrhagic infections of the biliary tract. In one of his cases blood reached the duodenum through the common duct and then regurgitated to the stomach; the primary cause was streptococcic cholecystitis. Kelling, in an article on the relation between cholelithiasis and ulcer of the duodenum, in speaking of the differential diagnosis between gall-bladder disease and ulcer of the duodenum, says that occult blood with duodenal ulcer may mean nothing; it may also come from infections in the gall-bladder.

Some months ago I operated on a patient in whom hemorrhage occurred regularly every few days. Ulcer could not be found, but cholecystitis with stones, and extensive scarring and œdema of the liver, which oozed a great deal as the gall-bladder was removed, were noted. The history of this patient is as follows:

CASE I (A374792).—Mrs. W. R. A., aged fifty-three years, came to the Clinic October 31, 1921, because of gastric hemorrhage. The history of trouble began nineteen years before with indigestion and upper abdominal cramps. The pain passed "through and through" the right hypochondrium and lasted two or three hours. Relief was obtained by soda or by hypodermic injections of morphin. After the pain had subsided the entire abdomen was tender. The patient had never been jaundiced. About ten years before she began to have attacks of gas and distress with belching two or three hours after meals; this was aggravated by certain foods, and was relieved by soda. In the past three years the distress had increased and usually commenced about one hour after meals. She was often wakened at night by the pain. After eating apples a few months before she was awakened by severe, acute indigestion

BLEEDING ULCER OF THE DUODENUM WITH CHOLECYSTITIS

which required a hypodermic. The next day she noticed black stool, and vomited small amounts of coffee-ground material. Shortly after this she was treated for ulcer and was pronounced cured. One month later she had a second gastro-intestinal hemorrhage, and since that time bleeding spells occurred at regular intervals. She had lost thirty pounds in weight.

Examination revealed systolic blood-pressure 135 and diastolic 85. The hæmoglobin was sixty per cent. Röntgen-ray examination of the gastro-intestinal tract was negative.

Operation was performed November 19, 1921. Hepatitis was very marked, the liver being almost cirrhotic. There was also chronic cholecystitis with stones, inflammation of the appendix, and œdema in the tissues at the pyloric end of the stomach. The ascending colon was bound down in a manner to suggest an old abscess. It was thought possible there might be a lesion causing the intestinal bleeding, but none was found. The gall-bladder and appendix were removed. The patient vomited a little bloody material on one or two occasions after the operation, but very shortly signs of improvement were noted. Although the time since operation is short, the patient is gaining and apparently is in better condition than she had been for a long time. Bleeding has entirely stopped.

Several years ago Crispin in the Clinic studied a series of cases of gall-bladder disease and found a history of gastro-intestinal bleeding in about five per cent. Communication with these patients revealed, in nearly every instance, that after the gall-bladder had been attended to bleeding ceased. In a recent review of all the cases of gall-bladder disease observed in the Clinic in 1918 and 1919, we found that hemorrhage was mentioned as a symptom in 2.43 per cent.

Rankin has recently reviewed the histories of fifty-five patients in the Clinic with blood in the vomitus, in the stool, or in both, but in whom a pathologic condition was found in the gall-bladder at operation. The average age of these patients was thirty-nine and one-half years, the oldest being sixty-seven and the youngest eighteen. There were thirty-six females and nineteen males, a ratio of almost two to one. In the majority of males diagnoses had been made of gastric or duodenal ulcer, but in many instances these diagnoses had not been verified by the Röntgen ray. The average duration of symptoms was twelve years, the shortest duration two months. Several patients had had symptoms for an indefinite period.

Thirty-seven patients gave a history of more or less typical gall-bladder disease; that is, attacks of epigastric colic, and nausea, vomiting, and residual tenderness, belching of gas, and some qualitative food distress. In nine patients the history was so suggestive of ulcer that a clinical diagnosis of ulcer was made, in spite of negative Röntgen-ray findings. In seven cases it was only possible to elicit an indefinite history of an upper abdominal condition which might have been considered as disease of the gall-bladder or stomach, or as reflex in character.

A clinical diagnosis was made of cholecystitis in twenty cases, cholecystitis with stones in fifteen, ulcer in nine, appendicitis in four, and indeterminate in seven. Blood appeared in the vomitus in thirty-two patients, in the stool in eighteen, and in both vomitus and stool in five. It is difficult

to judge at all accurately of the amount of bleeding, as it was only stated that the hemorrhage varied in amount from a few ounces to severe bleeding, producing anæmia.

Operations of drainage and removal of stones from the gall-bladder had been done elsewhere in three instances, and the appendix had been removed in seven instances. In thirteen patients constipation was so marked that they had constant recourse to cathartics.

TABLE I
OPERATIVE FINDINGS IN FIFTY-FIVE CASES

Grade	Cholecystitis	Appendicitis
1	16	17
2	25	11
3	10	11
4	4	1

The discrepancy in the total number of cases of appendicitis is due to the fact that seven patients had had appendectomies previously; moreover, at the time of operation at the Clinic, removal of the appendix was considered unwise or unnecessary in several instances, either because of the condition of the organ or of the patient. Cholecystectomy was performed in fifty-two cases, choledochotomy in four, cholecystostomy in one, and appendectomy in thirty-nine. The pathologic condition in the gall-bladder was reported either chronic or acute.

From the evidence of other observers and from my experience it may be concluded that hemorrhage into the stomach or intestine may occur when the lesion is in the gall-bladder or liver. It is difficult to determine at what point bleeding occurs or whether it is from several points.

Cases of cholecystitis in which there is occasional bleeding into the stomach or intestine should be grouped with the toxic cases of gastro-intestinal bleeding. Undoubtedly the bleeding is due to the effect of toxins from the infected gall-bladder or liver. It is generally known how severe hemorrhages may be in deeply jaundiced patients; sometimes bleeding occurs from all the surfaces of the mucous membrane, and is probably largely because of a changed condition of the blood, due to the presence of bile. It is possible, however, that some other change or disturbance of the functions of the liver may be the factor that results in changes in the blood or other tissue, thus allowing toxic bleeding. As our knowledge of these conditions increases, we look more and more to disorders of the liver to account for the obscure cases. It is possible that an ulcer of the duodenum may have been present in our fifty-five cases and not recognized, but since the bleeding ceased in most instances after operation on the gall-bladder it is fair to assume that the gall-bladder was the important factor.

Obscure gastro-intestinal bleeding occurs with many conditions. Obscure bleeding from œsophageal varices, particularly when associated with the toxic state in cirrhosis of the liver, has been widely discussed. There may be

severe bleeding in cases of anæmia associated with enlargement of the spleen and liver, and in certain cases of renal disease, and hypertension, endocarditis, arteriosclerosis, aneurism, and tabes dorsalis may be causes of obscure gastrointestinal hemorrhage. In any event, all obscure hemorrhages occurring in the stomach or intestines are not the result of infections in the gall-bladder; they may be the result of disturbances in the liver which have been brought about by any one of these causes.

Moschcowitz reported four cases of massive hemorrhage from the stomach without demonstrable ulcer, in which operation failed to reveal lesions in the stomach or any other condition to account for the bleeding. The patients all recovered after repeated transfusions and Moschcowitz was inclined to believe their condition to be the *exulceratio simplex* described by Dieulafoy, who, in two cases, had not found a demonstrable ulcer or lesion of any kind in examining the outside of the stomach, but in each instance on opening the stomach and brushing away the clots, a small abrasion of the mucous membrane which extended into the submucosa was found. In one of the cases Dieulafoy was able to show a small open arteriole at the bottom of the small break in the mucosa and submucosa. This probably constitutes a true, although minute and superficial, ulcer, and demonstrates that a great deal of bleeding may occur from a very small opening in the tissue. I believe it should not be assumed that this type of lesion accounts for all the cases of obscure bleeding; if it did, the condition would be reported more often at necropsy.

Apparently there are three regions in which similar obscure bleeding occurs. Bleeding from the stomach or intestine, when the mucous membrane is intact, may be comparable to bleeding from the nose when the mucous membrane of the nose and throat is intact, and is also comparable to bleeding from the kidney which is designated essential hæmaturia. In these three conditions the blood escapes from apparently normal mucous membrane. Although the tissues are swollen and œdematous, they are intact, and there is no way to explain the bleeding, except by oozing. Although the evidence is a little uncertain, I believe the cause is generally considered to be toxæmia, probably originating from any one of a number of sources and producing the same effect.

Many times the wrong diagnosis has been made through the error of thinking that if bleeding were associated with dyspepsia there must be ulcer in the stomach or duodenum. If blood was vomited the diagnosis seemed positive, but we now regard this symptom, and that of blood from the bowels, as occurring in association with other conditions in a certain percentage of cases. An abdominal exploration does not seem justified on the evidence of the bleeding alone, as the source of the difficulty may be more remote. However, since infections in the gall-bladder, biliary tract, and liver are undoubtedly often responsible, I believe that in operating on a patient with these symptoms, the biliary tract should be carefully investigated, whether or not there is an ulcer. It has been shown that twenty per cent. of patients

with duodenal ulcer have noticeable bleeding. Most of these patients are completely relieved of all their symptoms by gastro-enterostomy. In from about ten to fifteen per cent. of such patients bleeding recurs at some time after the operation. In most of these the bleeding may be the result of latent or revived infection in the duodenum at the site of the ulcer. It is possible, however, that it may sometimes be due to infection in the gall-bladder and that it might not have occurred if an associated infection in the gall-bladder had been recognized at the time of the operation for the ulcer. In operating on the stomach or duodenum it has been our custom to examine the gall-bladder and ducts, but I believe it is possible to overlook inflammation in the gall-bladder, unless we recognize the lesser degrees of inflammation that may occur.

We have an abundance of evidence to show that cholecystitis and hepatitis may be the source of the infection which results in bleeding, and I think we also have evidence which suggests that cholecystitis may be the source of the infection, causing this symptom even in the presence of ulcer of the stomach or of the duodenum.

REPORT OF FOUR CASES OF BLEEDING ULCER OF THE DUODENUM ASSOCIATED
WITH CHOLECYSTITIS

CASE I (A364189).—Mr. F. A. H., aged sixty-one years, came to the Clinic July 9, 1921, complaining of having had hunger pains for the last two or three years which disappeared on eating. He was supposedly cured by a gastro-enterologist, but about a month before our examination he began to lose his appetite, and his old discomfort returned. He noticed that his stools were dark-colored for several days. On two occasions he had had hemorrhage from the stomach, once with momentary loss of consciousness and once for five minutes. He had been on a liquid diet for some time and during the two weeks before examination had lost six pounds.

Examination revealed blood-pressure of 175 systolic and 100 diastolic. The prostate was somewhat enlarged, and the phenolsulphonephthalein return on two occasions was thirty and thirty-five per cent. Hæmoglobin was forty-three per cent. Röntgen-ray examination confirmed the presence of a duodenal ulcer.

At operation July 16, 1921, an ulcer of the duodenum was found on the anterior wall about 1.5 cm. below the pylorus; this was causing obstruction and dilatation of the stomach. The gall-bladder was infected and contained multiple stones. Gastro-enterostomy was performed and the gall-bladder removed. The patient's convalescence was uneventful, and he has been entirely well thus far.

CASE II (A325048).—Mr. H. Q., aged fifty-eight years, came to the Clinic July 15, 1920. He had always been well until three years before, when he passed dark stools, and was very weak afterward. Two years later he again passed considerable blood by bowel. He was put on a diet and improved rapidly. In March, 1920, while in Russia, he had another attack of severe bleeding from the bowel. He became very weak and his hæmoglobin dropped to thirty per cent. For about three weeks preceding the second attack he had had epigastric pain. Since his last attack he had had considerable dyspnoea and asthmatic-like attacks.

Examination revealed an anæmic man weighing 208 pounds, somewhat less than his normal weight. The systolic blood-pressure was 108, the diastolic 84. There was a blowing systolic murmur all over the chest and carotids. Urinalysis revealed albumin, casts, and pus. The hæmoglobin was thirty-eight per cent.,

coagulation time five minutes, and bleeding time one-half minute. Röntgenograms showed an ulcer of the duodenum. The electrocardiographic examination showed ventricular preponderance 3, on a scale of 1 to 4, chronic myocarditis, and aortic stenosis. The teeth and tonsils were septic.

At operation, August 6, 1920, a diffuse superficial ulceration on the anterior wall of the duodenum of the duodenitis type was found. The ulcer started about 1.25 cm. below the pylorus and extended for 5 cm., there was very little if any induration. The gall-bladder was definitely inflamed and contained stones; the liver was inflamed. A posterior gastro-enterostomy and a cholecystectomy were performed. The patient's convalescence was normal and he left the hospital in about two weeks. Several weeks later his tonsils were removed and his teeth treated. He recovered completely.

CASE III (A355215).—Mr. F. D. McC., aged forty-one years, came to the Clinic April 12, 1921. He complained chiefly of gas in the stomach and epigastric distress which had been intermittent for four years. The attacks came usually during the spring and fall and lasted for from three weeks to three months. At one time he was free from trouble for two years. The pain usually came on about five o'clock in the afternoon and then again from one to three in the morning. Relief was obtained by food and soda. He had his first hemorrhage from the stomach in 1919 and the second in 1921, when he also passed dark stools.

The patient was found in good condition except for his anæmia. The hæmoglobin was forty-two per cent. (about two weeks after his last hemorrhage). Röntgenograms revealed an ulcer of the duodenum.

Operation was performed April 20, 1921. On exposing the duodenum an old œdematous ulcer was found on the anterior wall of the duodenum which was attached under the liver. The gall-bladder was definitely inflamed and contained stones. The appendix was also subacutely inflamed. A posterior gastro-enterostomy was made and the gall-bladder and appendix was removed. The patient recovered completely.

CASE IV (A355365).—Mr. F. S. K., aged fifty-nine years, came to the Clinic April 14, 1921, complaining of recurrent hemorrhages from the stomach and bowel. The history of his trouble started thirty-three years before when he first had attacks of epigastric pain. The attacks lasted for from one to six months; he was then free from trouble for from one to two months, during which time he felt perfectly well. Epigastric pain began from two to three hours after eating and often awakened him at night. Food and soda afforded complete relief. He did not vomit during the attacks of pain, but had much belching of gas. These spells persisted intermittently for years. Nine years before he had passed tarry stools for five or six days and became very weak. Shortly after this he was operated on and a duodenal ulcer found. A gastro-enterostomy was done elsewhere. The patient was relieved for eight months, and again had trouble, but the attacks were shorter and less frequent than before the operation. They were relieved by soda and food. After the operation he had hemorrhages about once in six months, as evidenced by tarry stools, weakness, dizziness, and dyspnœa. He was treated medically on a number of occasions and was relieved of his symptoms. While on the train on his way to the Clinic he had passed profuse tarry stools; this was followed by weakness and dizziness. Increasing pain had persisted for many months. He had lost fifteen pounds in weight in the last four months.

At the time of our examination he was anæmic and weighed 147 pounds. The systolic blood-pressure was 180, the diastolic 110. An occasional hyaline cast was found in the urine. His hæmoglobin varied from fifty to sixty per cent. The gastric contents showed total acids 32, free acids 20. The combined phenolsulphonephthalein return was fifty-five per cent. in two hours.

The röntgenograms revealed a deformity of the duodenal bulb and a free gastro-enterostomy. Some time was required in raising his general resistance as much as possible for operation.

At operation May 3, 1921, an ulcer was found about one and one-half inches below the pylorus which had constricted the duodenum until it was only a small cord and would apparently permit little or no fluid to pass. This was ligated with two silk ligatures which were placed one above and one below the centre of the contracting scar. Examination of the old gastro-enterostomy showed it to be in good condition, with a large opening and no evidence of ulcer in the margin. The gall-bladder was definitely inflamed and contained one small stone. The liver was oedematous and hardened, with scars on the surface. The ulcerated area was occluded by silk ligatures and the gall-bladder then removed. Convalescence was very satisfactory for the first four days after the operation, when the patient had a sudden attack of abdominal pain, intermittent in character and not localized. On account of the arteriosclerosis we thought for a time that the pain might be anginal. The pain was completely relieved by a hypodermic of morphin, but returned again in a few hours, and his pulse became more rapid.

Leakage was suspected and the abdominal wound opened. The general abdominal cavity was in good condition, but there was a small pocket beside the duodenum containing duodenal contents which had leaked from an area of perforation through the old scar tissue where the ulcer had been. The pocket was walled off and free drainage established. The patient gradually grew weaker and died on the night of the sixth day.

When the duodenum was first examined in this case it seemed best to excise the scar tissue. At least it was considered absolutely necessary to destroy the ulcerated area to obviate the possibility of a return of hemorrhage. When the duodenum was partly mobilized, we realized that further procedure was not feasible, because the dissection of the scar tissue led into the pancreas, common, and pancreatic ducts. The idea of removing the ulcer was abandoned, and we attempted to place ligatures to control the blood-vessels to the ulcerated area. Possibly this reduced the circulation so that necrosis resulted; at least there was some change in the perforation on the fourth day after a normal convalescence to that time.

Necropsy showed that there was no true ulceration in the duodenum; its lumen was greatly reduced, but it was entirely covered by mucous membrane. While this patient had a rather marked arteriosclerosis and a large ulcerating area in the duodenum, cholecystitis with stones and hepatitis, I am, nevertheless, inclined to believe that if he had recovered after cholecystectomy, he would probably have been relieved of his intestinal hemorrhages.

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TRAUMATIC AND INDUSTRIAL HERNIA

REPORT OF THE SPECIAL COMMITTEE OF THE MEDICAL SECTION OF THE AMERICAN RAILWAY ASSOCIATION

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THE great increase in social legislation in recent years has made the subject of traumatic hernia one of vital importance to every industrial organization.

The first Workmen's Compensation Act was passed in Germany in 1884. Similar laws were soon adopted in Austria and later in Denmark, Norway and England. In 1916, thirty-three states and territories in the United States had enacted some form of Workmen's Compensation Act, and since that time, other states have been rapidly following the lead. Therefore, traumatic or industrial hernia, at first largely a question of theoretical interest, has become one of great practical importance. In spite of this, there has been no definite attempt made to standardize our knowledge of traumatic hernia, particularly as regards its etiology. In the recent past, the question of compensation has too often rested upon the power of the plaintiff's attorney to stir the emotions of the jury, rather than upon a carefully-weighed judgment based upon a knowledge of the facts relating to the origin of traumatic hernia. The time has now come when these cases are being gradually taken out of the hands of emotional juries—the members of which, no matter how fair-minded, are naturally lacking in the technical knowledge of the etiology and pathology of hernia—and being passed upon by experienced physicians. Therefore, it is of greatest importance that all of the facts bearing upon the etiology of hernia should be collected and classified and made readily available.

The term "traumatic hernia" has been used in a very general way to include, first, the small group of cases in which the hernia is due to direct violence; second, an occupational hernia, or perhaps, as better classified by the French, "hernia of effort," which includes all of those cases in which the hernia appears during heavy lifting, slipping, falling, coughing, sneezing, or any cause whatever which increases the intra-abdominal pressure; and third, "hernia of weakness" which is due to abnormal or defective development of the abdominal wall at the various hernial sites.

The first group of cases is so exceedingly rare that it may be disposed of in a few words. In true traumatic hernia due to direct violence the tissues must have been punctured by some more or less sharp object which has forced its way at least through the muscles and fascia, if not quite to the peritoneum. Personally, we have never seen a case of true traumatic hernia. We have known of one treated by one of our colleagues; the muscles about the inguinal canal were torn by the horns of a bull and a hernia developed shortly after.

So this group of cases can be practically ruled out of consideration. The latter group, hernia of weakness, due to congenital weakness of the abdominal muscles or weakness through disease, causing atrophy of the muscles, also very rare, as weakness alone without the presence of a pre-formed congenital sac, rarely results in a hernia no matter how great the intra-abdominal pressure. These are practically all of the direct type.

The very large group of cases which is ordinarily designated as traumatic hernia and which should be more properly called occupational hernia, or better still, hernia of effort, furnishes the basis of nearly all of the medico-legal or compensation cases of hernia. The word "rupture," the old English name for the disease hernia, is responsible for the traumatic theory of the origin of hernia so widely held by the laity as well as by many medical men who have given but little study to the subject. This theory gained a foot-hold before operation for the radical cure came into general use and before the etiology of hernia was generally understood. With the rapidly increasing knowledge of the subject derived from a very large number of operations that have been performed in the last quarter of a century, our ideas of the causes of hernia have gradually changed. At present, it is almost universally recognized that the all-important cause of hernia of all varieties is the presence of a pre-formed sac of peritoneum known as the processus vaginalis. This view was held by two noted surgeons of the eighteenth century. Pellatin and Cloquet; but only in recent years did Russell of Australia, by his patient investigations, force us to conclude that practically all hernias are of congenital origin due to this open pouch of peritoneum which has existed since birth. Unfortunately, courts and juries, and compensation laws here and abroad, have not kept pace with the developments of surgery and it is still not unusual to see large damages awarded in cases of so-called traumatic hernia. Russell maintains that an acquired hernia does not exist and recognized authorities on hernia have come to agree with Russell's conclusions.

Prior to the adoption of the Workmen's Compensation Acts, there were a considerable number of medico-legal decisions in cases of so-called traumatic hernia both in Europe and in America. Many of our compensation boards have simply followed along the lines of decisions handed down by European courts. Sheen (*Practitioner*, London, 1909) who has made a careful study of the subject of traumatic hernia in England, states that "the arbiter in these claims, in the mass of ill-understood technicalities, following the lines of least resistance, has given judgment in favor of the workingman—the post hoc ergo propter hoc view being naturally considered the easiest one."

In Switzerland a person suffering from a hernia and desiring compensation, is entitled to indemnity only on the following conditions: (1) It must appear suddenly; (2) It must be accompanied by pain; (3) It must be of recent origin; (4) There must be proof that the hernia did not exist prior to the accident.

In Germany, in order to establish a claim, the sufferer from hernia must have had an examination within forty-eight hours of the accident; the hernia

must have appeared suddenly, must have been accompanied by pain and must have immediately followed some accident. Proof must be furnished that there was no hernia prior to the accident.

While there are no published records showing the results of the New York State Compensation Board, Sellenings, through the courtesy of a medical officer of the commission, has obtained certain important data. The commission thus far has considered traumatic hernia as extremely rare. The opinion was ventured that it occurred in possibly one of ten thousand cases.* Commenting upon these statistics, Sellenings states:

"1. Traumatic hernia is but a surgical curiosity and assumes no practical importance; 2. Only a small number of the cases have been carefully investigated; 3. A great proportion of the cases seem to be relegated to the convenient classification of 'vocational hernias.' Whatever may be said of the attitude of the New York Commission applies equally well to many other sections of the country."

One of the most recent and on the whole judicial discussions of the subject Traumatic Hernia, or, as the author terms it, "Compensable Hernia", is contained in a book on "Industrial Medicine and Surgery" by Harry E. Mock (Assistant Professor of Industrial Medicine and Surgery at Rush Medical College) published in 1919.

Mock calls attention to the fact that "the decisions of established medicine date back to the precompensation days and were based on the testimony of expert authority made in the courts of England especially, and later in our own courts, to the effect that a traumatic hernia could only occur from a direct violence resulting in a definite tearing or rupture of the abdominal wall.

* Since this report was made, the following data have been very kindly furnished to us by Mr. Frank V. Whiting, General Claims Attorney of the New York Central R. R. Co. He writes:

"The New York Compensation Commission has never published any statistics or information in relation to hernia.

"For some time, the Board has rather inclined to the view taken in your Committee's report, that is, that hernia is not generally the result of a trauma, yet, there was an unwritten rule established that if the employer offered a correcting operation, and it was refused, an award would be made for eight weeks' disability and the case closed. This practice has prevailed up until very recently.

"In the case of *Al. v. P.*, 223 N. Y. 97, decided two or three years ago, a hernia was claimed as the result of a strain, and the award was made, but subsequently denied by the New York Court of Appeals, on the ground that there was no cause or relation between the strain and the rupture. This resulted in a strengthening of the prevailing opinion that trauma was a doubtful cause of the hernia.

"However, recently, beginning with the case of *J. v. D. C.*, in the Court of Appeals, decided March 15, 1921, there has been a trend the other way. The *J.* case specifically decided that the facts indicated that the claimant, while lifting a box of clay weighing over 700 pounds, strained his side and a hernia resulted, and the Court stated that there was no doubt that it was an accidental injury within the meaning of the statute, and rendered a decision accordingly."

These quotations are sufficient to show how completely at sea both Courts and Compensation Boards are at the present time, on the subject of Traumatic Hernia.

All other hernias were claimed to be due to congenital defects, pre-formed sacs, and were similar to all other diseases which might occur coincidental with occupation but not related to it. Such testimony was sustained by practically every court and their views were considered as the decisions of established medicine." He states that, naturally few claims for traumatic hernia were made, although employees in those days, just as frequently as at the present time, blamed their work for the condition.

The greatly increased number of claims for compensation for hernia at present, he regards to be due partly to the new attitude on the part of industry in the direction of recognition of certain moral obligations as well as the realization that any improvement in the condition of employees renders them more useful and more efficient. He states, that among broad-minded employers, the question of whether there was such a thing as traumatic hernia for which they could be held legally responsible, caused little concern.

"They were not governed by the decision of established medicine nor of established law but based their decisions upon a just and good business sense. If they employed a man with a hernia they knew the industry was not responsible for it. If it grew gradually worse without any definite accident or excessive occupational effort it was due to natural causes and again they were not responsible. But, if as a result of accident or severe strain this hernia became strangulated, at once doubt as to responsibility entered the case and the decision was, therefore, rendered in favor of the employees. If they hired a man who showed no sign of rupture at his employment examination, but who later suffered an accident or a severe occupational strain and as a result the hernia appeared, compensation and free surgical care were given because in the man's mind the accident caused the trouble, and because they recognized that to a certain extent the occupation was contributory to the final development of the condition.

"From the standpoint of efficiency it was found that a man with hernia was about 25 per cent. less efficient than the man without one. Therefore, these concerns might refuse to employ men with a rupture but they became more and more liberal regarding the repair of such a condition when it developed in an old employee."

Mock states that, "Such was the attitude of several concerns at the time of the passage of the employees' compensation acts. In fact those very laws were an expression of this new humane influence which had entered industry. The administration of these acts were placed in the hands of industrial commissions whose members were laymen rather than lawyers. Influenced by the generous attitude of certain industries, and guided by this sentiment and a consideration of moral rights, combined with their meagre decision of these various commissions were often at variance to those rendered by the courts in the past.

"Thus employees began to seek compensation for many conditions which heretofore had not been considered compensable, and included among these were hernias which developed during employment."

Mock states, "The question of traumatic hernia, therefore, simmers down to three considerations:

1. A proper definition of what is meant by traumatic hernia;
2. To what extent must an accident or an occupational hazard which only partially contributes to the development of a condition be held responsible for same;
3. In which cases should compensation be paid by the employer."

Mock fully agrees with our own opinion and that of practically all surgeons who have had much experience with hernia, that, hernias as a result of direct violence are very rare. He states that many of the best authorities have enlarged the scope of traumatic hernia so as to include those cases which result from the indirect application of force causing greatly increased intra-abdominal pressure. This adoption of a broader definition, however, Mock believes would mean the inclusion of many additional hernias in the compensable group thus greatly confusing the question. We believe it would be much better to restrict the name of traumatic hernia to the very small group limited to direct violence.

Other types of hernia for which the occupation is more or less responsible, are described by Lotheissen and other writers as "accidental hernia."

Mock has personally observed only five cases of true traumatic hernia due to direct violence at the point where the hernia developed. He cites these five examples as follows:

"(1) Man struck in the right groin by the sharp end of a crowbar; (2) a brakeman was crushed between the bumpers of two cars and a ventral hernia appeared; (3) a man was running through the aisle at fire drill and struck his left inguinal and scrotal region against a truck handle. A large contused area, swelling and hemorrhage into the scrotum immediately followed. Within three days a definite left, direct inguinal hernia appeared; (4) a pregnant woman was kicked in her left lower abdomen by her husband and very shortly a ventral hernia appeared and naturally increased in size as pregnancy developed; (5) a cowboy came to my clinic with two enormous oblique inguinal hernias. He gave a history of some two years previously having had a horse he was riding rear and fall over backward, pinning him beneath the saddle. The pommel of the saddle had crushed into his lower abdomen. Immediately there was bulging in both groins and these continued until they had reached the present size. The man denied any sign of rupture previous to the accident."

In at least the fifth case of Mock's series (enormous double oblique inguinal hernias) it would seem almost certain that there must have been present congenital sacs, or rather, an early stage of hernia on both sides prior to the accident, and the enormous increase in intra-abdominal pressure in this case further developed the pre-existing condition. Mock himself admits that, "It is quite evident that even in these cases of inguinal hernia following direct violence, some doubt will always exist as to the possible presence of

a congenital predisposition for hernia." He very truly affirms that, "Industrial Commissions all over the country are depending on the surgeons in industry to arrive at a just and equitable decision concerning this subject of compensable hernia."

Mock believes that, "The first essential is to make a careful physical examination of all employees and to record those who have real or potential hernias. Whenever a hernia develops in one of these employees who was recorded not to have a hernia, a careful analysis of his case must be made to determine: (1) was it entirely due to pre-existing defect? (2) was it entirely due to some severe direct or indirect violence? (3) was a latent condition already present and only aggravated by the unnatural occupational hazard? (4) was it due entirely to natural causes? (5) or was it due to a combination of all of these, and if so, which was the most responsible?"

Mock admits that, "The great majority of hernias develop slowly, 'the gradual dilatation of a pre-formed sac.' The congenital defect or predisposition is the chief cause for such hernias and the relations of natural occupation or of the natural acts of ordinary life are immaterial in their formation. These correspond to the gradual development of 'flat-foot' a result of faulty shoes, constant standing and walking or other natural causes; or to the development of tuberculosis in employees engaged in occupations which in no wise predispose to this condition."

MacCready, the greatest English authority on hernia, states that an acquired hernia is never due to an accident or single increase of intra-abdominal pressure.

Graser, one of the highest German authorities, states that a hernia complete in all its parts can never arise at the moment of accident or by a single increase in the intra-abdominal tension be it ever so great.

Moschcowitz, of New York, who made a very careful study of hernia in relation to the Workmen's Compensation Act (*Med. Rec.*, April 3, 1915), concludes: "Traumatic hernia is exceedingly rare. It may occur in any part of the abdomen, but usually *not* at the site of the normal hernia openings. Workmen's Compensation Commissions are not and cannot be acquainted with all the facts relating to hernia. This is evidently the sphere of the medical profession; the Workmen's Compensation Commission should be required to place implicit reliance upon the decision of established medicine. In cases of appeal from the decision of the Commission, all the medical part of the testimony should be given by experts of the court's selection, and not of the selection of the claimant or defendant."

A fact particularly emphasized by Doctor Hopkins is, that the great majority of hernias in industrial practice, particularly in railroad work, are found in foreigners, and nearly all in men who have not previously passed a physical examination. One of the reasons why they occur more frequently in foreigners is, we believe, the fact that the class of foreigners engaged in the lower grades of railroad labor are, as a rule, either under-nourished at the time, or went through a period of under-nourishment during childhood,

which tended to lessen the normal development of the abdominal wall. Another reason for the higher percentage of hernias in foreigners, particularly those coming from Russia and Southern Europe, may be found in the practice so widely prevalent among these people, of trying to produce artificial hernia in order to escape army duty. Doctor Gerster, of New York, called attention to this factor many years ago; and recently, at the Hospital for Ruptured and Crippled, Doctor Hogust observed a double direct hernia, regarding which the man stated he had produced it himself. The method of production was: taking a hard, slightly blunted stick, placing it over the inguinal canal and then striking moderate blows from time to time with a mallet until the muscular structures in the neighborhood of the canal are torn or pushed to one side and finally a hernia develops. Here again we must observe that it does not occur as the result of a single blow or single injury. It is only the repeated blows with this more or less sharp instrument that finally produce such a weakness as to cause a direct hernia to follow.

Of all the attempts made by the different State commissions to solve this vexed problem of traumatic or industrial hernia, the industrial commissions of Nevada and California stand out as most in accord with our present knowledge of the causes of hernia. The following is a ruling of the California Industrial Commission:

"The consensus of medical and surgical opinion runs to the effect that hernia is very rarely, in any proper sense, the result of an accidental injury; that the accident is at best no more than the occasion, instead of the cause of the malady; that the origin of the difficulty is congenital and more in the nature of a disease than an injury; that every claim for compensation based upon an alleged rupture is to be viewed with suspicion."

The Nevada Commission rules:

"Medical science teaches now what it has taught for the past twenty years and is now accepted as a medical and scientific truth, corroborated as such by the foremost surgeons and anatomists in the world; that is, that hernia, or so-called rupture, is a disease, ordinarily developing gradually, and is very rarely the result of an accident."

The following rules have been promulgated by the Nevada Commission:

"Rule I. Real traumatic hernia is an injury to the abdominal wall (belly wall) of sufficient severity to puncture or tear asunder said wall and permit the exposure or protrusion of the abdominal viscera or some part thereof. Such injury will be compensated as temporary total disability, and as partial permanent disability, depending upon the injured individual's earning capacity.

"Rule II. All other hernias, whenever occurring or discovered and whatsoever the cause, except as under Rule I, are considered to be diseases, causing incapacitating conditions or permanent partial disability, and the causes of such are considered, as shown by medical facts, to have either existed from birth, to have been years in formation, or both, and are not compensatory, except as provided under Rule III.

"Rule III. All cases coming under Rule II in which it can be conclu-

sively proved, first, that the immediate cause which calls attention to the presence of the hernia, was sudden effort or severe strain or blow, received while in the course of employment; second, that the descent of the hernia occurred immediately following the cause; third, that the cause was accompanied or immediately followed by severe pain in the hernial region; fourth, that the above mentioned facts were of such severity that they were noticed by the claimant and communicated immediately to one or more persons, are considered to be aggravations of previous ailments or diseases, and will be compensated as such for time or loss only, depending on the nature of the proof submitted and the result of the local medical examination."

Our Committee is entirely in accord with Rules I and II of the Nevada Commission. It, however, calls attention to a serious conflict in Rule III of the second proof, which must be given in order to establish a right for certain compensation. Rule II states specifically that by medical facts it is shown that a hernia either exists from birth or is years in formation; whereas, in the second proof of Rule III it speaks of a descent of hernia occurring immediately following a strain or blow. This assumes that hernia may be the result of a single increase of abdominal pressure which the Commission in Rule II stated to be impossible.

Many writers state that a recent hernia is tender and painful on manipulation, and ecchymosis is not infrequently present. This statement is frequently found in text-books and particularly in articles upon Traumatic Hernia. We believe it has no basis in fact. In an experience of 31 years at the Hospital for Ruptured and Crippled, where we have an average of 5000 new cases a year, there has not been a single case of recent hernia which was "tender," painful, and accompanied by ecchymosis in which there had been a history of antecedent injury or accident of any form. We have seen a number of cases that were attributed to an injury, and we are of the opinion that the patients honestly believed that the injury was the cause of the hernia; yet the size of the hernial ring, the thickness of the sac, with adhesions to the surrounding structures, all proved beyond the shadow of a doubt, that the hernia was of long standing, although probably not previously recognized by the patient. A recent case, only observed in October, 1921, is a very good illustration of this point. A man, 25 years of age, employee of the New York Central Railroad Company, with a history of never having had any swelling whatever in the region of the hernial canals, shortly after heavy lifting, noticed a swelling in the right inguinal region. He came to the Emergency Hospital of the N. Y. C. R. R. Co., where the attending surgeon found a well-marked inguinal hernia, the size of a small egg, in the right inguinal region, extending well into the canal and upper scrotum. In the opinion of the surgeon, this was one of the most definite cases in his experience pointing to a causal relationship between the strain and the hernia, and it might have been so regarded, had not the patient consented to an operation. On October 14, 1921, Doctor Coley operated and found a pre-formed sac undoubtedly of congenital origin, extending well into the upper scrotum, 2 1-2 inches long and 2 inches broad, considerably thickened, firmly adherent to the overlying

ing cremaster muscle. The nature of the sac clearly proved it to be of congenital origin and, in all probability, the hernia itself had existed for months or possibly years although the patient may never have recognized it until the time of the unusual strain, when a somewhat larger amount of omentum or bowel was forced into the sac, causing slight pain which first called his attention to the hernia.

Hernia is practically always due, first, to the presence of a pre-formed sac or open pouch of peritoneum which, in the inguinal variety, follows the testis in its descent into the scrotum, which pouch has failed to close in the normal way; and second, to the presence of structural weakness in the neighborhood of the hernial orifices due to poorly developed muscles or fascia. Given these all-important anatomical causes which are in themselves sufficient in many cases to constitute a potential hernia, the actual hernia may develop by reason of a great variety of exciting causes; among these may be mentioned, the daily increase in intra-abdominal pressure incident to the ordinary routine of life, e. g., straining at stool, coughing, sneezing, lifting, etc. The main point that cannot be emphasized too strongly is that the hernia is never the result of a single strain or single increase in intra-abdominal pressure due to any of the causes mentioned; on the other hand, it is the cumulative effect of a great number of strains spread over a considerable period of time. In nearly all cases hernia is of gradual onset, and is rarely accompanied by pain, and most frequently remains unnoticed until it has reached a considerable size or until some accident or strain by slightly increasing the contents of the hernia sac, causes it to be noticed for the first time. Hence, the accident or strain is usually the occasion which first attracts the attention to a hernia long present but hitherto undiscovered. It has been a matter of almost daily observation at the Hospital for Ruptured and Crippled to find a patient applying for a truss or for operation for a hernia on one side, when careful examination discloses the fact that he has a hernia on the other side, almost, if not quite as large as that for which he applied for treatment. The size of the hernia and the character of the sac as determined by operation prove beyond question that this hernia existed for a long period and was quite unrecognized by the patient. Hence it is true, that, in many cases a person who claims that his hernia is due to an accident or an injury may sincerely believe this to be the fact, because he was unaware of the presence of a swelling prior to the accident, although it had really existed for months or years before. In many other cases, however, the contrary is true and claim for indemnity or large damages is made upon a corporation, for a hernia which the claimant well knew had existed for a long period prior to the accident. In some cases, evidence of his having worn a truss for a long period of time is apparent. We, personally, have seen many cases of this type in our medico-legal work and in some instances the sympathetic jury has awarded very large damages. In all of our experience we have never seen a single case in which there was any sound basis for the claim that the accident or injury was the cause of the hernia. In many cases the jury has been convinced by expert testimony that a hernia could not have been caused by the accident mentioned

and have rendered a verdict accordingly, but on the other hand, in other cases, all of the expert evidence has been brushed aside and the jury has allowed its sympathy for the claimant to outweigh the seemingly slight loss of a few thousand dollars compensation to the supposedly wealthy corporation. One case which we recall is that of a man of about 50 years of age, who claimed to have been thrown forward against the back of the seat in front of him in a slight collision. The slight increase in intra-abdominal pressure was made the basis for his claim that a large double, inguinal hernia was the result of the accident, although there was no evidence of local injury at the site of either hernia. In spite of expert evidence to prove the fact that a double hernia is never the result of trauma, that these hernias were both too large to have been of recent origin, the jury, as we remember, awarded very large damages (\$15,000.00). The verdict was so palpably against the evidence that the decision was reversed by the Supreme Court.

At present the situation in regard to dealing with the question of traumatic or industrial hernia may be described as chaotic. There are, however, a few States in which the members of the Workmen's Compensation Commission apparently have made a scientific study of the subject before formulating any rules and in these States the subject is treated in a most fair-minded and judicial way; in other States, however, the rulings are apparently based on the old and long-discarded ideas as to the etiology of hernia with the result of great financial loss to the interested corporations and in the end distinct harm to the individuals.

What then is the remedy? The only thing needed to bring about greater harmony in the procedure of industrial commissions, is to spread broadcast a clearer knowledge of the well-known medical and surgical facts relating to the etiology of hernia. We must recognize that medical and surgical truths permeate but slowly, especially when they have to overcome long-established traditions too often supported by court decisions. The first is to convince the commissions and the courts of the well-established surgical fact that hernia is a disease and not the result of an accident. When this has been done a radical review of the present State laws regarding compensation in cases of industrial hernia will be forthcoming.

RECOMMENDATIONS

1. Render proper compensation for all cases of true traumatic hernia due to direct violence. Such cases are so few in number as to be practically negligible.
2. Make a physical examination of all applicants for positions in industry no matter in what capacity; such examinations will determine the fact whether or not a hernia was present at the time of examination.

Doctor Hopkins, in a recent paper on Traumatic Hernia, reveals the important fact that of all the men who passed the physical examination prior to entering the railroad service, the claim of traumatic hernia amounted to less than one per cent.; while, on the other hand, ninety-one per cent. of the cases of alleged traumatic hernia were found to occur in foreigners (Greeks,

Italians and Poles), who did not have a preliminary physical examination before being admitted to the service.

3. Any case of hernia developing in the course of duty, incident to the man's daily work, should be treated as a disease due to special anatomical weakness on the part of the individual, for which the Company is in no way responsible. If it is considered wise under certain circumstances to recognize any moral responsibility, let it be on an economic or humane basis. This moral obligation should be understood to be strictly limited to such employees who had been found apparently free from hernia at the time of previous physical examination.

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NON-TUBERCULAR KIDNEY INFECTIONS*

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INFECTION of the kidney by pathogenic microorganisms may take place by way of the urinary passages, the lymphatics, or the general circulation. The hæmatogenous route is especially important on account of its often obscure starting point and its production of a great variety of local lesions. The infectious agents in the blood stream reach the kidney through the renal capillaries, in the form of a single bacterial species in pure culture, or as a mixed infection. Albarran's statement still holds good, that with the exception of lesions produced by the tubercle bacillus, our knowledge of other renal infections is as yet incomplete. The three observations of non-tuberculous kidney infections, reported in the following, concern a case of kidney carbuncle, a fulminating acute and a chronic dead kidney. All three cases were the result of hæmatogenous infection of the organ with pus-producing bacteria.

A great significance must be attached to hæmatogenous infection of the kidney, which is the eliminating organ for microbes in the general circulation and is therefore liable to damage through the bacteria themselves or their toxic products. The starting point of kidney infections is extremely variable and often situated at a considerable distance from the organ. The cortical lesion of the kidney or localization of the blood infection, from which the perirenal suppuration originates, may be so small as to escape detection even at the time of operation. These metastatic infections will give rise either to diffuse suppurative nephritis, to focal suppuration within the renal cortex, or to perirenal or pararenal suppuration with a trifling cortical lesion. All these conditions are merely different degrees of one identical process, namely the localization in the renal cortex of pathogenic agents which have been carried there by the blood stream in the course of bacteriæmia, usually staphylococcus bacteriæmia. Metastatic hæmatogenous infection of the kidney or perinephritic abscess secondary to a small pus focus elsewhere in the body is not always easily recognized, but on the contrary in acute cases lends itself readily to confusion with acute intra-abdominal infection.

The name of metastatic carbuncle of the kidney was first applied by Israel to metastatic hæmatogenous abscess of the renal parenchyma and perinephritic abscess, which may follow upon practically all suppurative or infectious processes of the rest of the body, especially boils and felons. An instructive example of perinephritic abscess which was later found to have an associated carbuncle of the kidney, recently came under my own observation, offers a good illustration of this not uncommon hæmatogenous origin of kidney suppurations.

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CASE I.—The patient, a young man of nineteen years, sustained a punctured wound of the left forearm, which became infected and was incised by his physician. Some days later he began to complain of severe pain in the mid-abdominal region, and was referred to me at St. Vincent's Hospital. This pain finally localized under the left costal margin, with occasional sharp twinges radiating down the left thigh. On the third day of the abdominal pain, the patient had a chill, and his temperature rose to 103° F. Murphy's sign was present in the left costo-vertebral angle. Urinary symptoms were altogether absent. The diagnosis was perinephritic abscess and the treatment consisted of incision and drainage. The staphylococcus aureus, which had previously been recovered from the infected wound of the forearm, was also recovered from the kidney pus. His post-operative course was quite irregular. Temperature after operation dropped to 101° F., but on the third day it rose again to 103° F. Drainage was satisfactory for eight days, but his irregular temperature and negative digital exploration of sinus for pus pockets, together with negative urinary findings, suggested further urologic investigation. Cystoscopic examination by Dr. Herbert Mohan, on the thirteenth day post-operative revealed equal function from both kidneys. The urine still free from pus and bacteria. However, a pyelogram of the left kidney showed a small renal pelvis, with upper and lower calyces long and narrow, but no sign of middle calyx. The following day left nephrectomy for carbuncle of the kidney was done, and the patient made an uneventful recovery. His present condition shows absence of all symptoms and a gain of forty pounds in weight. The value of urologic examination after drainage of a perinephritic abscess, where the patient presents signs of a continued sepsis, cannot be overemphasized.

The specimen of this solitary staphylococcus suppuration in the kidney (Fig. 1), derived from a remote pus focus, is very striking. The organ is the seat of a peculiar lesion which in color and consistence contrasts so sharply from the surrounding healthy tissue as to suggest a new growth rather than a suppurative process. Beginning in the renal cortex near the surface, the process has developed essentially at the expense of the cortical tissue, advancing inwards towards the central area of the kidney.

Similar conditions existed in Israel's classical case of metastatic carbuncle of the left kidney, observed in 1891 and reported ten years later in his *Klinik der Nierenkrankheiten* (1901). He emphasizes that this observation concerns the first case on record in which this process of metastatic infection by the blood stream could be demonstrated and points out that undoubtedly hæmatogenous infection may be restricted not only to a single kidney but even to a circumscribed portion of the organ.

A different and more advanced degree of metastatic hæmatogenous infection of the kidney is represented by a personal observation in a case of acute fulminating kidney in a man 57 years.

CASE II.—The patient twenty-four hours before admission to St. Vincent's Hospital was suddenly attacked by sharp pain in the lower right lumbar region, radiating into the right groin and the testicle. These painful attacks lasted half an hour to an hour and were repeated several times daily, becoming progressively more severe, and associated with vomiting, nausea, and hæmaturia. He gave a history of an accident several years previously in which his right hip and a rib were fractured, and remembered a sudden attack of sharp pain in the lower right quadrant in the course of convalescence.

Cystoscopic examination by Doctor Mohan revealed considerable pus coming down from the right kidney. The function of the right side considerably lower than the left. Right pyelogram showed a marked dilatation of the pelvis and ureter with indefinite obstruction in the lower third of the ureter about one and one-half inches from the bladder; one suspicious small scratch on right ureteral catheter. The general condition of the patient became more serious every hour, and operation advised. The next day nephrectomy was done. The kidney found to be considerably enlarged with several areas of subcapsular hemorrhage. At the center there is a large soft area, bluish-black in color, about the size of a walnut. The pelvis is greatly distended. No evidence of calculus or stricture found. The ureter likewise considerably distended and an associated periureteritis extended from the lower third up to and involving the pelvis. Pathological examination of the kidney showed marked changes of acute pyelonephritis with an exudate of pus in the ureter and pelvis extending into the parenchyma, involving the tubules and interstitial tissues, and extending up to the renal cortex. The patient's recovery is especially gratifying in view of the fact, as emphasized by W. J. Mayo, that in the fulminating type of hæmatogenous pyogenic infection, unless nephrectomy is done, death may result within a few days. Observations like the foregoing are more or less suggestive of latent microbism, a problem which attracted much attention during the World War in connection with the healing of wounds. In Brewer's case of acute hæmatogenous infection of one kidney in a woman of twenty years, the condition was preceded about three weeks by double femoral fracture and multiple contusions of the body.

CASE III.—The following case of chronic infectious nephritis and pyelo-nephritis, culminating in "dead kidney," occurred in a man of seventy years whose distressing condition was greatly relieved by drainage of the pus. This patient had suffered five years from urinary retention and when first seen had a persistent sinus of the right kidney of two years standing with a suprapubic fistula of the same duration. Three years previously he was taken suddenly ill with pain and tenderness in right hypochondrium and lumbo-dorsal region. This later proved to be a perinephritic abscess, which was opened and drained through an anterior incision. At the same time the operating surgeon performed a suprapubic cystotomy, evidently because of his attacks of urinary retention. His convalescence was protracted because of remittent fever and backache. The kidney sinus finally healed but opened again one year later just after a prostatectomy by still another surgeon.

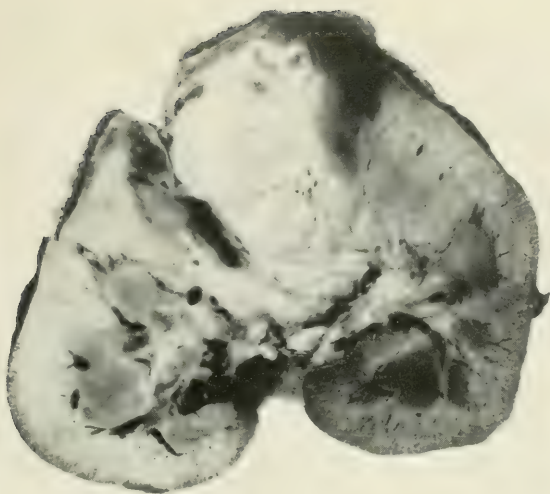


FIG. 1.—Kidney carbuncle. (Cross section.)

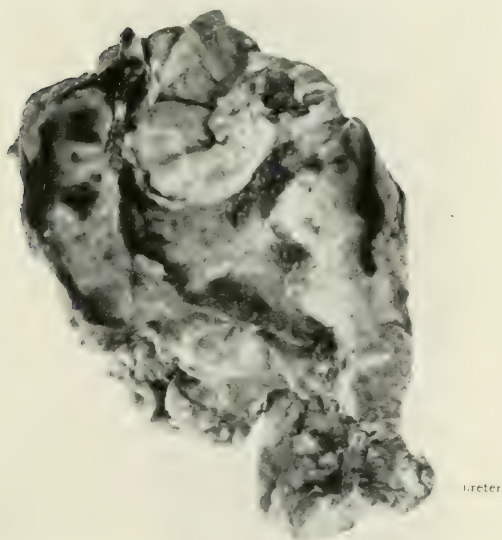


FIG. 2.—Terminal pyelo-nephritis, dead kidney.
(Cross section.)

When first seen by me the patient was bedridden, presenting two discharging sinuses, one from the kidney incision and the other from the suprapubic. There was a constant discharge of pus and urine from a urethral catheter which was kept in the bladder. Cystogram revealed his bladder capacity of about one drachm. He was considerably benefited by our first treatment, which consisted of enlarging the kidney sinus and removing several sloughs. About six weeks later right nephrectomy was performed and a dead kidney removed. His convalescence was quite satisfactory except for a persistent fistula which was found to lead to the ureter stump. Seven weeks after the nephrectomy our secondary operation was performed to remove the ureteral stump containing a calculus. Notwithstanding his advanced years and prolonged sufferings, the patient finally made a good recovery, gained in weight, and was able to go about with all fistulae closed. His bladder capacity on discharge was sixteen ounces. The findings on macroscopical and microscopical examination were as follows:

Macroscopic Examination.—The specimen consists of right kidney. With the surrounding fat it measured $12 \times 9 \times 4$ cm. The kidney proper measured $9 \times 3 \times 2.5$ cm. It is very irregular in shape and nodular. The parenchyma is almost completely replaced by fibrous tissue, containing several small cysts near the surface. The pelvis and upper part of the ureter are greatly dilated and surrounded by adipose tissue. The mucous membrane of the pelvis is rough and covered with grumous exudate.

Microscopic Examination.—The sections show most of the glomeruli to be completely obliterated and replaced by hyaline connective tissue; some show beginning fibrosis with a thickened Bowman's capsule; none appear to be normal. The tubules show the various stages of degeneration from a granular change in the epithelium to complete destruction. Some of the tubules are cystic and contain an exudate consisting of pus cells and granular material. The interstitial tissue shows generalized lymphocytic infiltration. Many areas show localized infiltrations consisting of lymphocytes, polymorphonuclear neutrophils, plasma cells and eosinophiles. There are several areas of extravasated blood of recent formation. The mucous membrane of the pelvis is replaced by a membrane consisting of plasma cells, eosinophiles and lymphocytes. There is considerable perivascular infiltration throughout the organ.

Although serious lesions like those described above calling for the removal of the infected organ are a frequent sequel of the penetration of pus-producing bacteria, it is entirely possible for the ordinary pyogenic micro-organisms, especially the staphylococcus, to pass through the kidney without necessarily giving rise to important anatomical lesions.

The *pathogenesis* of deep abscess in general and perinephritic suppuration in particular, was not well understood prior to Pasteur's discovery of the staphylococcus in the pus of the furuncles and its demonstration as the responsible agent in these and other suppurative processes (1881). Some years later, Verneuil in France pointed out on the basis of an illustrative observation that the germs of furunculosis may find a favorable culture medium in a

weakened organism and may multiply freely at a considerable distance from their primary focus, giving rise to a collection of pus. His patient was a physician thirty-two years of age who suffered from a voluminous perinephritic abscess, as a sequel of a furuncle on the upper lip, three styes of the eyelids, and a boil on the cheek. Albarran one year later (1889) applied experimental injections of staphylococcus and colon bacillus cultures into the ear vein of rabbits, and by inflicting lumbar contusions in these animals succeeded in producing perirenal suppurations from which the injected pathogenic agent could be recovered. This observation established the fact that perinephritic abscesses can and do follow not only upon an infected wound of the perirenal region, but also upon a blood infection derived from an organ situated at a distance from the kidney. The source of the infection, may, accordingly, consist not only of a severe general disease but a distant and perhaps apparently insignificant focus is often responsible. In such cases perirenal localization of the germs is favored by more or less definite factors, such as traumatism or exposure.

Etiology.—A distinction must be made between abscesses propagated to the kidney from other organs by continuity and abscesses of purely metastatic character which form in the renal cortex through embolic transportation of infectious agents in the renal arteries. These abscesses are usually due to the staphylococcus aureus, as in my own observation, and often assume a relatively mild type, whereas acute streptococcal infections of the kidney, as pointed out by W. J. Mayo are apt to be extremely malignant and are fortunately rare. Pus-producing bacteria, which reach the kidney parenchyma by the hæmatogenous route, are apt to lead to the formation of metastatic parenchymatous, perinephritic, or paranephritic abscesses; and these may follow upon practically all suppurative or infectious processes in the entire body. Traumatism in the form of a blow or kick in the renal region sometimes acts as a determining factor in the localization of the lesions.

It is now understood that the pathogenic micro-organisms which have penetrated into the blood current may pass through the kidney, which is the eliminating organ for microbes in the blood current, without giving rise to serious lesions of the kidneys themselves or the excretory passages, and without apparently modifying the composition of the urine. Existing lesions of the renal cortex may be so trifling as to escape detection on superficial examination. The character of the pus in these infections naturally varies according to the character of the blood infection. The staphylococcus aureus is usually found following upon boils and felons, while in other cases the streptococcus, the pneumococcus, the gonococcus, the colon bacillus or anaërobes may be demonstrable. The two latter are found more particularly in perinephritic suppurations following upon lesions of neighboring organs, such as the colon or duodenum.

The subject of metastatic hæmatogenous perinephritic abscess has recently been discussed by Cleisz, in a Paris Thesis (1919), who reports six unpublished cases of staphylococcus aureus infection from the service of Lecène.

One of these cases was observed and operated upon before the war in 1913; the five others came under observation and treatment during the war. Four patients gave a history of felons or boils, one had previously suffered from an attack of influenza, and one from severe tonsillar angina with metastatic suppuration of the elbow. It is important to keep in mind that metastatic perinephritis may be a sequel of practically all suppurative or infectious lesions of the entire body, notably boils and felons, but also general diseases such as typhoid fever, influenza, measles, smallpox, gonorrhœa, peritonitis, empyema. The most important and perhaps the most frequent mode of origin of kidney suppuration, accordingly, is hæmatogenous infection in the form of metastatic parenchymatous or perinephritic abscess.

Symptoms and Diagnosis.—The clinical picture of the disease was well described several years ago by Albarran, and no essential addition has since been offered in the literature. The onset is insidious, and the behavior of the temperature is irregular. Pain, although the earliest and most constant symptom, often the only one during several days or weeks, is likewise very variable and may be deep, dull and diffuse, or sharp and radiating in different directions according to the seat of the abscess. Deep pressure in the costo-lumbar angle usually elicits or aggravates the pain. Brewer has pointed out that a marked costo-vertebral tenderness is the one pathognomonic sign present in all cases. In advanced cases percussion with the patient in a suitable position often yields absolute indefinitely outlined dullness. In the extra-renal infections, lumbar swelling is very important and when fairly well marked, may obliterate the costo-iliac notch or even produce a visible lumbar protuberance. Œdema of the skin is very important and constitutes a valuable sign, which alone permits the differentiation of perinephritic abscess from intra-abdominal infection. Cutaneous reddening and fluctuation which may make their appearance in abscesses, with a tendency to point posteriorly towards the skin of the lumbar region, are late symptoms and should never be given time to develop.

A sudden attack of pain in the kidney region, especially when associated with fever, in an individual known to have a suppurative process somewhere in the body should at once give rise to a suspicion of metastatic abscess in or about the kidney. The seat of the pain varies with the location of the focus and may be lumbar or abdominal. The patient's complaints are often misleading, so that the condition may be confused with gall-stone disease or other abdominal affections, which moreover sometimes complicate the renal infection. The diseased kidney is not always indicated by the location of the pain, which has been known to occur on the healthy side, but the modified function of the affected organ will be indicated by the renal functional test, even if the cortical lesion is slight (Braasch).

Changes of the Urine are usually inconsiderable and may be altogether absent. Serious alterations, pointing to an involvement of the kidney, have been noted only in exceptional cases. Microscopical hæmaturia, a few leucocytes, or traces of albumin, are occasionally found, and are sometimes

temporarily demonstrable in the urine. When the urine is normal and there is nothing in the patient's history to draw attention to the kidney, the diagnosis may prove very difficult, although much valuable information can often be obtained through cystoscopic and bacteriological examinations, renal functional tests and radiography.

Differential Diagnosis.—Urological evidence must be carefully secured, for it is only by the functional examination of the kidneys that the cause of the persistent fever can be traced to a destructive process in the kidney. A complete examination includes catheterization of the ureters, a report of the findings in the two separate urines, cystoscopy and uretero-pyelography. In the carbuncle case described above cystoscopy and pyelogram proved the conclusive factor of assistance for the necessity of further surgical intervention. Pyelography is helpful in ascertaining the degree of renal destruction. In advanced cases, the dilatation of the pelvis and calyces may be so considerable as to assume the proportions of a pyonephrosis.

Cystoscopic and other urological methods of examination may be unsuccessful for the reason that the focus is closed off from the outside and does not communicate with the efferent urinary passages. Gross changes of the urine, indicating renal involvement, are only exceptionally present.

In obscure cases, exploratory exposure of the suspected kidney may be necessary. Incision of the abscess alone, without exposure and inspection of the organ, cannot be relied upon to reveal the actual condition of the infected kidney. Fever, sometimes chills, and slight tenderness on pressure may be the only symptoms until the peritoneum becomes involved, when another difficulty arises in the differentiation of the kidney lesion from the diseases of other organs in which the peritoneum is apt to participate. On the right side, which according to some observers is much more frequently affected than the left side, cholecystitis and appendicitis must be excluded. It is also necessary to exclude typhoid fever, malaria, general infections of undetermined character, as well as all conditions associated with backache of a diffuse bilateral type. The backache of perinephritic abscess is localized in the costolumbar angle. The formation of a swelling in the renal region may suggest some intrathoracic, pleural or pulmonary affection or an abscess of the lumbar wall. Erroneous diagnosis of disease of the abdominal organs, notably the liver, gall-bladder, or appendix, must be carefully avoided. However, as pointed out by Braasch coincident infection in the gall-bladder or appendix as well as the kidney is not infrequent. Tenderness on pressure below the twelfth rib, and sometimes considerable increase in the size of the kidney, are valuable signs pointing to the existence of an intrarenal abscess.

The differential diagnosis loses some of its difficulties when the possibility of perinephritic abscess is kept in mind, especially when the patient's previous history reveals the existence of a small suppurative process, notably a boil or felon. A sudden onset of lumbar pain in these cases is supposed to correspond to the development of the cortical abscess.

The rendering of an early correct diagnosis is of the utmost importance,

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for surgical intervention is indicated. As stated by Keyes, perinephritic abscess should be diagnosed and drained as early as possible. Spontaneous absorption comes too late and is too uncertain.

Treatment.—The treatment of these infected kidneys, which have gone on to localized or generalized pus formation may be obtained by nephrotomy, resection of the kidney or nephrectomy. I agree with Keyes that it will frequently be wise to postpone nephrectomy until drainage shall have relieved the patient of his acute sepsis.

Resection has sometimes been followed by recovery, but the toxæmia is apt to persist for several weeks after the operation, because septic foci have been left behind, so that extirpation of the entire diseased kidney is often preferable especially in weakened patients. Nephrotomy, or resection exposes to the disadvantages of slow healing and secondary hemorrhage; moreover, it is not free from the possibility of a persistent fistula. It enters into consideration, however, as a conservative procedure in those cases where the infectious process is not widely distributed. The removal of the diseased organ prevents the distribution of the suppurative process in the body and protects against the involvement of the opposite kidney. In a general way, and on the basis of numerous considerations nephrectomy is the simplest, most radical, and most promising procedure.

CONCLUSIONS

1. That the kidney is the eliminating organ for circulating microbes, and in the course of this elimination may itself be damaged in a variety of ways.
2. Hæmatogenous infection may be restricted not only to a single kidney, but even to a circumscribed portion of the organ.
3. The source of the infection may not only be a general disease, but a distant and apparently insignificant focus may be responsible.
4. Metastatic hæmatogenous infection of the kidney perinephritic or paranephritic abscess is not always easily recognized, and may be confused with intra-abdominal infections.
5. A sudden attack of pain in kidney region associated with fever in a patient known to have a suppurative process elsewhere in the body should excite suspicion of metastatic kidney infection.
6. Cystoscopy and pyelography are valuable aids especially when urinary changes are incomplete, or the symptoms are referred to the healthy side.
7. The treatment of perinephritic or paranephritic abscess is early drainage. Where the suppuration involves the kidney parenchyma, or where the process is an acute fulminating one—nephrectomy is indicated.

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NOTE ON THE DIAGNOSIS OF SHADOWLESS RENAL CALCULI* WITH ESPECIAL REFERENCE TO THOSE OF CYSTIN COMPOSITION

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It is common knowledge that a small percentage of renal calculi fail to cast shadows in an X-ray plate. Holmes and Ruggles state that with satisfactory technic "probably eighty to ninety per cent. of kidney and ureteral stones will show." Those occasional calculi which present no greater density than the body soft parts are chiefly of uric acid or urate composition. Much has been written concerning the diagnosis of these elusive stones. The two cases herewith presented, however, offer an interesting point in diagnostic technic which has not been frequently emphasized.

CASE I.—(Surgical No. 14733.) A Russian housewife, aged twenty-six, entered the hospital complaining of pain in the right side. Her family history was unimportant. She had had measles, mumps, and scarlet fever in childhood, and tonsillitis on several occasions in later years. At the age of twenty-three she had influenza with pneumonia, and eighteen months before admission a thyroidectomy was performed.

Two years before coming to the hospital she first complained of slight pain in the right upper abdomen and in the lumbar region upon the same side. This discomfort was of frequent occurrence, and it was often associated with activity or fatigue. It was never present at night, and could always be relieved by lying down. The attacks were very transient, and the patient, who was pregnant, attached to them little significance. The pains were occasionally accompanied by vomiting. They bore no apparent relationship, however, to activities of the gastrointestinal system. There was no jaundice. Save for slightly increased frequency of voiding, ascribed to pregnancy, there were no urinary symptoms.

One year before admission there occurred suddenly at night an attack of very severe pain in the right upper abdomen beneath the ribs, and radiating posteriorly to the back. The suffering was of several hours' duration, and relief was obtained only through morphia. The patient vomited repeatedly; she felt alternately cold and warm. She complained of great urgency associated with inability to void more than a few drops at a time. She did not observe the urine carefully but no blood was seen. The attending physician told her that she probably had a kidney stone. The pain gradually disappeared. The slight twinges previously described, however, continued without change, and after several months there occurred a second period of intense discomfort, comparable to the first one, but less severe.

For several weeks before hospital entry, the pains were of more frequent occurrence, and the patient finally applied for treatment at the Out-door Clinic. There, X-ray studies were negative, although there was slight movement during the examination and the plates were not completely satisfactory. Because microscopic blood was found in the urine, admission to the wards was advised.

Examination found an obese young woman, whose appearance was not suggestive of distress or critical illness. Temperature, 99°; pulse, 92; respirations, 20. The neck bore the scar of a thyroidectomy. The abdomen presented

* From the Urological Clinic of the Peter Bent Brigham Hospital.

slight tenderness and resistance to palpation, in the right upper quadrant. The kidneys were not felt, although obesity made accurate observations difficult. There were no other significant physical findings. The urine was alkaline, clear and pale, and contained neither albumen nor sugar; specific gravity, 1.012. A few white blood-cells were found in the sediment. The excretion of phenol-sulphonephthalein in two hours was thirty-five per cent.; hæmoglobin, ninety per cent.; white blood count, 7600.

Cystoscopy found the bladder normal. Both ureters were readily catheterized. Microscopic examination found the urine from the right kidney to contain many red blood-corpuscles, and no pus. An occasional red cell was found in the specimens from the bladder and left kidney. In the test of divided function the dye appeared promptly and with excellent intensity upon the left side. The excretion in ten minutes was five per cent. Upon the right side fifteen minutes elapsed before any color could be seen and then but a faint trace appeared. All cultures were sterile. Satisfactory X-ray studies confirmed the negative observations previously made in the Out-patient Department. X-ray report: "Plates with the catheters *in situ* show distinctly the outlines of the right kidney. The kidney shadows are not enlarged and there is no evidence of a calculus shadow within either kidney region, along the course of the ureters, or in the bladder."

A pyelogram was made upon the right side. At first glance the result was normal in appearance. There was not the slightest evidence of dilatation of the renal pelvis; the calyces were slender and cupped. In the centre of the main collecting portion of the pelvis, however, where the depth of fluid should be greatest and the shadow therefore densest, closer scrutiny found an oval area of definitely decreased density. If a large air bubble had been introduced at the time of injection it might have been given a similar picture (Fig. 1).

Following this examination, the patient complained of recurrent slight attacks of her typical pain. Several days later cystoscopy was repeated. A wax-tipped catheter was passed along the right ureter and a second right pyelogram was made. The plate was an exact duplicate of the first one, above described. The wax bulb showed linear scratches which were unmistakably of calculus origin.

The two pyelograms were thought to denote the presence of a shadowless calculus within the pelvis of the right kidney, appearing as it were by negativity, through displacement of the denser opaque solution. Holmes and Ruggles state that "papillomata may produce round holes in the thorium shadow." In this instance, however, the patient's story and the wax-tip scratches were sufficient evidence for the exclusion of tumor and the diagnosis of stone. A right pyelotomy was therefore performed and a calculus was removed from the pelvis of the kidney. The operation was without noteworthy incident. The convalescence was equally uneventful, and the patient was discharged to her home on the eighteenth post-operative day.

The stone measured 1.7 cm. x 1.7 cm. x 1 cm. It weighed 2.16 grams. It was lemon yellow in color and glistening as though dusted with sugar (Plate I). In composition it was pure cystin. (Analysis by Dr. Cyrus H. Fiske, Department of Biological Chemistry, Harvard Medical School.)

Cystin calculi are rare, and they have not been thoroughly discussed in the literature. Concerning their visibility in X-ray plates there seems to be little accurate information. General opinion and clinical experience classify them as shadow-casting stones. Holmes and Ruggles, for example, have asserted that they are very dense. Thompson Walker in "Surgical Diseases of the Genito-urinary Organs," wrote that "oxalate of lime stones are the least permeable to the rays and throw the densest shadow; the rare cystin

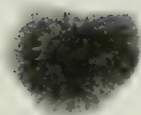
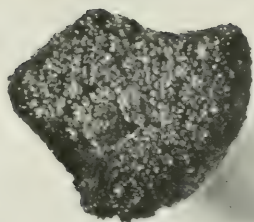


PLATE I.—Above: A calculus of pure cystin. Drawing enlarged to twice actual size for the purpose of greater detail. Below: Röntgenogram of the stone after its removal. Its spongy texture is well shown.



FIG. 1.—Case I. Pyelogram in which a shadowless stone appears as an area of lessened density, in the center of the renal pelvis.

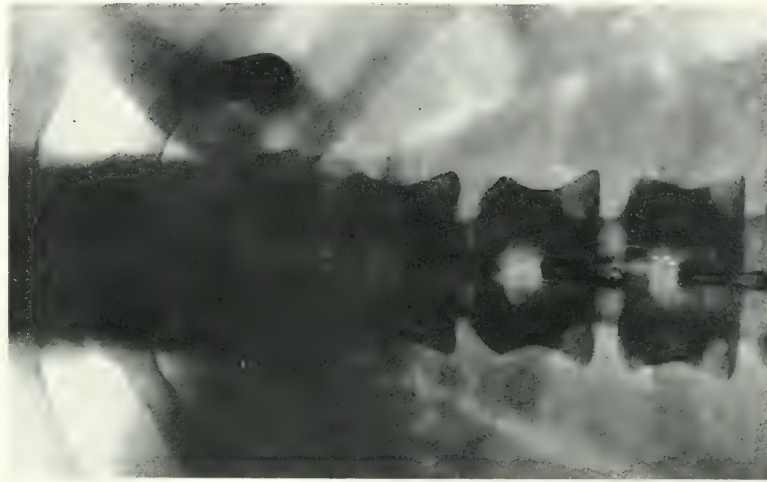


FIG. 2.—Röntgenogram of the region of the stomach, made immediately after the taking of capsules containing bismuth and cystin. The form shows distinctly near the cardia. The encapsulated cystin could not be seen.

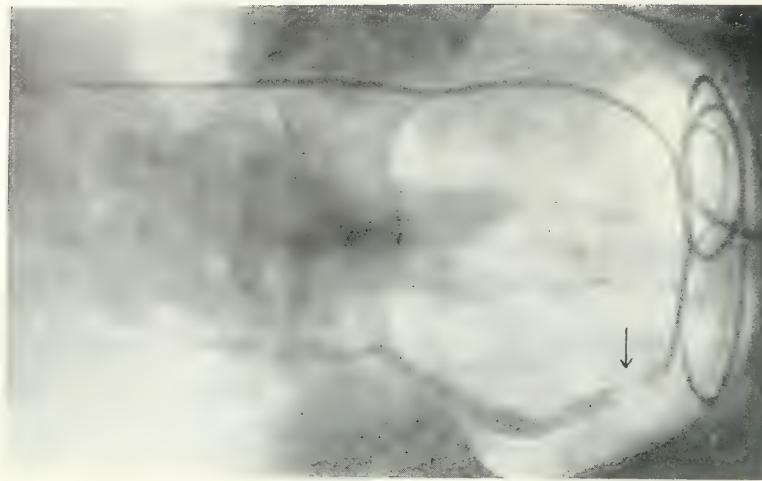


FIG. 3.—Case II. Ureterogram. The clear area in the line of injection beyond the catheter tip, marks the presence of the stone. Note the dilatation of the ureter above the level of obstruction.

and xanthin calculi throw a shadow slightly less dense; calcium phosphate is next. . . . In an aseptic case the absence of a stone shadow after two or more examinations, when a plate of first quality has been obtained, excludes all but a pure uric acid calculus." In his "Practice of Urology," Chetwood stated that oxalate and phosphate stones "give a distinct image, and those of cystin, which are rare, also cast a faint shadow."

Clinical discussions concerning calculi of this type testify similarly that they are readily shown in X-ray plates. Morris, in 1906, wrote a paper devoted to the "X-ray Shadows of Cystic and Xanthic Oxide Calculi." The stones which he examined were from a museum collection. Of only one had there been a pre-operative radiogram. This stone had apparently cast a good shadow. It had been removed from the bladder of a boy of seven. It was of large size, but there is no complete description of its physical characteristics. In composition it was cystin with four-tenths per cent. inorganic residue. Müller, writing in 1911, recited at length the story of a young man of twenty-one who formed cystin stones with ungovernable persistence. Röntgenograms of both renal regions gave shadows of calculi on several occasions. Three nephrotomies and a litholapaxy were performed. The stones varied from millet-seed concretions to coral calculi of considerable size. The single chemical analysis given in this case reported, "cystin with a phosphate crust." From his observations Müller concluded that cystin stones are readily revealed by the X-ray. Wolf, Kienbock, and Neumann have also described their experiences with shadow-casting cystin calculi.

In spite of this unanimity of opinion, as expressed by radiologists, writers of text-books and clinicians, a pure cystin calculus in Case I, presented above, failed to reveal itself in two X-ray examinations. It should be borne in mind in this connection that cystin is an amino-acid, a normal constituent of protein. There would seem to be little reason to expect concretions composed solely of this substance to possess greater density than the body soft parts. For possible further evidence the following observations were made:

Two large gelatine capsules (Lilly's Size 000) were packed, one with bismuth subcarbonate (gm. 2.34), and the other with pure cystin (gm. 1.1). They were then coated with paraffin to keep them intact in the presence of the gastric secretion. A paraffin-covered gelatine capsule had been previously proved to be shadowless. The capsules were swallowed in quick succession, four and one-half hours after a light breakfast. Röntgenograms of the upper abdomen were made immediately, and again after about fifteen minutes. In both plates the control bismuth capsule was, of course, clearly visible and sharply defined. The cystin capsule could not be seen (Fig. 2).

The evidence at hand suggests that stones of pure cystin are shadowless. This statement should not be made, however, with too great finality. As noted by Arcelin in his excellent discussion, the opacity of a calculus is determined not alone by its composition, but by its thickness and structure as well. "The number of atoms making up a given thickness can modify considerably the

transparency of a stone, quite apart from the specific opacity of its elements." This is of fundamental importance. Because of differences in structure alone, therefore, it is possible for two stones of the same composition and thickness to present different degrees of permeability to the X-ray, one being of loose texture, and the other perhaps harder and more compact. Obviously it is not possible to judge definitely concerning the shadow-casting properties of any calculus without full knowledge of its size and structure, as well as of its chemistry. Even concretions of uric acid are not invariably shadowless. It is probably fair to say in general, however, that pure cystin calculi, with their characteristic loosely-knit structure, should be classified among the relatively invisible stones. Unusually compact structure, large size, or admixture with inorganic substances, may account for exceptions to this rule, and may explain some of the results of other observers.

CASE II (Surgical No. 11159) is of less interest in this study. The röntgenogram, however, is strikingly similar to one presented by Stevens in 1917. A brief discussion of the case follows:

An American electrician, aged forty-five, entered the hospital complaining of pain in the left side. There was no family record of importance. The patient had had many of the childhood infections, among them scarlet fever in severe form at the age of six. At fifteen, he was acutely ill with what was thought to be "congestion of the kidneys." For several years before coming to the hospital he had complained of severe headaches.

Eight days before admission, he suffered a gradual onset of agonizing pain in the left lumbar region and flank. The attack was of brief duration and it subsided following the giving of an enema. There were repeated recurrences, however, and in the intervals there was persistent dull discomfort in the lower back upon the left side. The severe pains began in the lumbar region and extended forward into the flank and groin. On one occasion there was definite radiation to the genitalia. Nausea, vomiting, and headache accompanied the later attacks. There was no fever. The physician in attendance found no blood in the urine. Because of continued pain hospital entry was decided upon.

Examination found a well developed and fairly nourished man of middle years. He was nervous and apprehensive, but his appearance was not suggestive of acute illness. The temperature was very slightly elevated; pulse and respirations, normal. There was definite costo-vertebral tenderness on the left side. The routine physical examination was otherwise unimportant. The urine contained a slight trace of albumen and a small amount of pus and microscopic blood. The leucocyte count was 9000. X-ray studies of the urinary tract revealed no evidence of calculi. The left kidney was large and low.

Cystoscopy found a normal bladder. There was occasional slight bleeding, however, from the left ureteral orifice. The right ureter was readily catheterized and the right kidney was apparently normal. The left ureter presented definite obstruction at a point three cm. above the level of the bladder. X-ray plates were then made with the radiographic catheters *in situ*. There appeared at the tip of the left catheter a very small, faint area of opacity. It was circular in outline and, in its appearance, suggestive of the ordinary phlebolith. A more positive picture was furnished by the ureterogram in which again a stone was shown by negativity. Beyond the catheter tip, and interrupting the shadow of the filled ureter, was an oval vacuole of decreased density, about one cm. in length. Above this point there was well-marked ureteral dilatation (Fig. 3). The picture was

SHADOWLESS RENAL CALCULI

obviously produced by a relatively shadowless calculus displacing the opaque solution. The small shadow shown before injection, if a part of the stone, may have been its denser nucleus.

The passage of the calculus was not accomplished by intra-vesical measures and the patient refused operation. He was, therefore, discharged. In answer to a recent letter of inquiry he has informed us that he passed his stone several days after leaving the ward. Unfortunately we have no knowledge concerning its composition and physical characteristics. The calculus in the similar picture noted by Stevens was of the urate group.

CONCLUSIONS

It is apparent that, following the injection of an opaque solution into the ureter and renal pelvis, invisible stones may sometimes be shown by negativity.

Contrary to the general opinion, calculi of pure cystin should be classified in general with those concretions which possess no greater density than the body soft parts.

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INTRA-ABDOMINAL HEMORRHAGE FROM RUPTURED CORPUS LUTEUM*

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INTRAPERITONEAL hemorrhage may arise from various sources, most often from a ruptured ectopic pregnancy. Aside from hemorrhages of a purely traumatic origin, such as ruptured liver, kidney, spleen or pancreas, spontaneous rupture of the uterus may be mentioned. Very rarely, exceedingly serious intra-abdominal hemorrhage occurs, traceable to none of these sources, but either to a ruptured graafian or atretic follicle or to a ruptured corpus luteum.

A survey of all the available literature on intra-abdominal hemorrhage from ruptured corpus luteum impressed me with the fact that in none of the cases reported, so far as we have been able to ascertain, was the correct diagnosis made before operation. The reason for this is quite apparent; intra-abdominal hemorrhage following rupture of the corpus luteum is a rare occurrence compared with the other pathologic conditions which present an almost identical picture, and it is only natural that the diagnosis which most often fits a condition should be the one made.

It would seem that hyperæmia with engorgement of the blood-vessels could occur more readily in the ovary than in other less vascular structures. Hence it is not surprising that hæmatomas of the ovary are often found. It is reasonable to assume that when the graafian follicle is ripe and its ovum is extruded, the particular spot where the break occurred is weaker for a time, at least, than other portions of the ovary which had not been ruptured recently. Benthin² claims that even after the formation of the corpus luteum these sites remain very thin and are separated from the peritoneal space by an easily breakable layer of connective tissue.

It has been quite definitely proven that trauma plays a considerable part in the production of ovarian hemorrhage. Novak⁸ quotes von Beust as having found nine cases out of thirty-six where trauma was considered the etiologic factor in producing the hemorrhage. He mentions one case occurring during a dance, one the result of a misstep and one due to intrapartum compression of an ovary. Several authors, Rubin,¹² Novak,⁸ mention having cysts rupture during bimanual examinations, especially under ether, and at the laparotomy which followed having found the collapsed cyst with bloody fluid in the pelvis. Primrose¹¹ reports two cases; one patient was apparently perfectly well until she lifted a heavy box, whereupon she felt a sudden, sharp pain in her abdomen; the other patient's condition was complicated by acute appendicitis. Both women were taken violently ill two days before men-

* Read by title May 19, 1921, at the Meeting of Ex-resident Physicians of the Mayo Clinic.

struation was due. In the first case, Primrose found active hemorrhage coming from a ruptured corpus luteum, and in the second from a ruptured graafian follicle. Primrose argues that the strain from lifting the heavy chest caused the rupture in the first case, and that in the second case strain from vomiting during an attack of acute appendicitis ruptured the graafian follicle. Dansey's patient was seized with acute abdominal pain following straining at stool. The peritoneal cavity was found to be full of bright colored blood and both ovaries showed recent corpora lutea with hemorrhages.

It seems reasonable to conclude that any factor which excessively increases the hyperæmia of an ovary can produce ovarian hemorrhage. Whether this hemorrhage becomes intra-abdominal or intra-ovarian depends largely upon the point of least resistance, the weakest spot being the one to give way.

REPORTS OF CASES

CASE I.—Mrs. A. L., aged twenty-nine years, came for consultation December 27, 1915. She complained of dull, aching pains low in the abdomen, principally on the left side, which had begun about two weeks before. The pain continued intermittently until three days before examination, when she was suddenly seized with knife-like pains, without radiation, in the same location, so severe that they doubled her up. The pain lasted about fifteen minutes, and after it subsided she was weak and her side was sore. The following night the attack was repeated, but it was not so severe. There was no nausea, vomiting, fever or vesical disturbance. Menstruation had always been regular, a moderate flow for four or five days, until the two last periods, which were five days late, with slight flow of only two days' duration. There was no pain. She developed morning sickness, her breasts became large and tender, and she thought she was pregnant. She had had one child.

General physical examination revealed soreness and tenderness in the left lower quadrant of the abdomen. Pelvic examination made under ether disclosed the presence of an indefinite mass in the left side. A diagnosis of extra-uterine pregnancy was made.

At operation the following day the pelvis contained free and clotted blood. The uterus was slightly enlarged. The left tube and ovary and the right tube were normal. The right ovary, however, was somewhat enlarged and had a small clot protruding from a ruptured corpus luteum. This was resected and the ovary sutured. The patient recovered uneventfully.

Microscopic examination of sections of the ovary showed a typical corpus luteum which had ruptured.

CASE II.—Mrs. B. C. W., aged thirty-seven years, had been married twice. The first marriage was at the age of twenty-seven, and the second three months before examination. She had matured at the age of thirteen with regular menstruations of the twenty-eight-day type. The last period was on June 6, 1920. She had never been pregnant. She appeared to be perfectly healthy, except that she was troubled with constipation. She ate and slept well. June 27, 1920, she was feeling absolutely well at ten in the morning and was preparing to go

on an outing, when she was suddenly seized with severe, excruciating pain around the navel which gradually increased, and radiated to the lower costal margins. After taking some magnesia she felt nauseated and vomited.

The patient was seen by Dr. Leo A. Schroeder at 4.30 P.M. Her temperature was 98.7°, her pulse was 84. The systolic blood-pressure was 120, and the diastolic was 90. There was no abdominal distention and no rigidity of recti. At 7.30 P.M. I was called in consultation. At this time noticeable rigidity of both recti was present with marked tenderness over McBurney's point. Palpation caused increased pain in the epigastrium. The abdomen was otherwise negative. We were

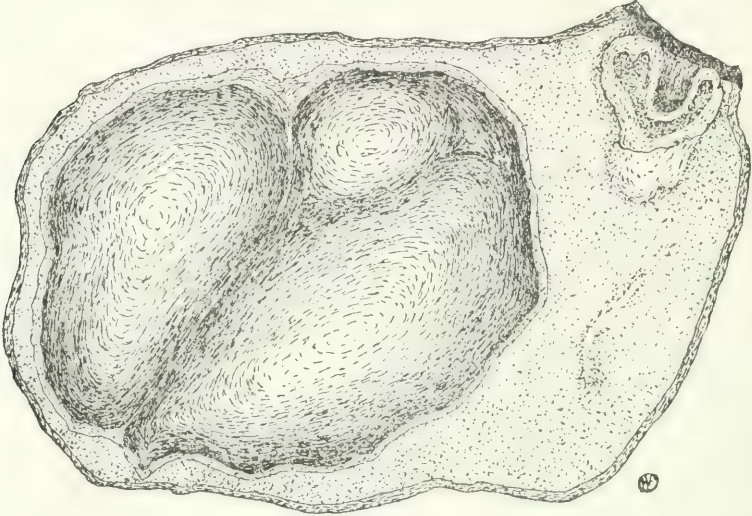


FIG. 1.—Sectioned ovary with ruptured corpus luteum.

so confident that this was a case of appendicitis that, like nearly all the surgeons whose reports have been tabulated, we did not make a blood count.

At 9 P.M. we operated through a McBurney incision. On opening the peritoneum, the abdominal cavity was found filled with blood. The incision was immediately extended downward so as to expose the uterus and adnexa. The hemorrhage was discovered on the upper posterior surface of the right ovary and looked as though it were coming from a normal corpus luteum. The ovary was clamped, and the remaining abdominal organs were examined, all of which, including the appendix, appeared to be normal. The right ovary was again examined and the clamp removed in order to verify our former observations and to prove to our satisfaction that this was the source of bleeding. Bleeding began immediately, not an ooze, but rather a brisk hemorrhage. The greater part of the ovary was removed; the stump left was 0.6 cm. wide. After the abdominal cavity had been filled with normal salt solution the incision was closed in the usual way. The patient made a normal recovery and left the hospital on the tenth day.

Pathologist's report: The specimen is a cystic ovary hardened in formalin. It measures 3.0 by 3.5 by 2 cm. Attached to the upper pole is a firm clot 1 cm. in diameter. On section, immediately beneath the blood clot, there is a corpus luteum about 1 cm. in diameter. (See Fig. 1.) A cyst filled with a gelatinous substance occupies about three-fourths of the ovary. Microscopic sections show a typical corpus luteum which has ruptured.

COMMENT.—In order better to study these cases a tabulation was made of those it was possible to obtain from the literature. The author's own words have been used whenever space permits. The list is smaller than it would be if I had had access to more of the literature on this subject since I included data of only the original articles which I had read. (See Table.)

In general the reports show that the symptomatology of this condition is characterized by sudden abdominal pain, cramplike or colicky, followed almost always by nausea and vomiting. There is nothing characteristic about the temperature and pulse. Localized abdominal pain and tenderness, generally on the right side, are noted almost immediately after the onset of the sudden pain. Frequently abdominal rigidity and distention are present. The patient is pale, but seldom seems to be in shock. While these symptoms in a woman are characteristic of trouble in either the appendix or fallopian tube, the possibility of a hemorrhage from the ovary must be considered, especially if the patient shows a marked degree of pallor or anæmia.

There was practically no blood work done, or if done, it was not reported. I believe that a knowledge of the percentage of hæmoglobin, or a complete blood count, in the two cases reported herewith, might have helped in making a better diagnosis, particularly in the second case. Marital relations do not seem to play a part, since quite a number of the hemorrhages occurred in young unmarried women.

Speese¹³ believes most such hemorrhages occur during or within a few days of the menstrual period. In Bookman's³ case hemorrhage occurred seven days after normal menstruation and in Warnshuis'¹⁴ case fourteen days after. In Adams'¹ case the patient expected to menstruate at any time, and after suffering for three days from acute abdominal pain, vomiting and diarrhœa, normal menstruation began and lasted five days. On the following day, which was the ninth of her illness, she was operated on and the abdomen was found to contain three pints of blood-stained fluid and clots. In my second case the patient was taken ill seven days before her period was due. Conclusions cannot be drawn from this small number of cases as to the rôle which the menstrual function plays in these hemorrhages. Neither does it seem to determine the kind of follicle to be ruptured in case hemorrhage occurs, this being demonstrated by the two cases reported by Primrose.¹¹ In his first case the hemorrhage was due to a ruptured corpus luteum and in the second case to a ruptured graafian follicle, yet in both cases the

CASES REVIEWED OF INTRA-ABDOMINAL HEMORRHAGE FROM RUPTURED CORPUS LUTEUM

Author	Age	Symptoms	Abdominal pain and tenderness	Nausea and vomiting	Temperature and pulse	Abdominal distention and rigidity	Sudden increase in abdominal pressure	Pallor	Blood findings	Normal menstrual history	Married	Pregnancy	Diagnosis before operation	Free blood in the abdomen	Ruptured corpus luteum	Complicated with appendicitis
Hind (1905)			Sudden pain		Patient pulseless, unconscious			*		*	*	0		Several pints of clotted blood	Left ovary	
Ladinski (1910)	22	Not mentioned	Sharp attacks of pain; tenderness most marked in right inguinal region			Moderate distention							Tubal pregnancy	Large amount of fluid and large clots	Left ovary	
Primrose (1912)	35	Two days before menstruation	Sudden severe pain tenderness general; most marked in left iliac and hypogastric regions	Nausea; frequent vomiting	97.6 130	Marked distention; rigidity	Accidental strain while lifting heavy chest	*		*	*	3½ years before		Large amount; clots	Left ovary	0
Primrose	40	Two days before menstruation	Acute pain; tenderness in right iliac region	Violent attack of vomiting	88.6 80	Rigidity	Accidental strain while vomiting			*	*	0	Appendicitis	Large amount; dark blood clots	Ruptured graafian follicle R + Ov.	Acute septic

INTRA-ABDOMINAL HEMORRHAGE

Warnshuis (1912)	17	Fourteen days after menstrua- tion	Severe pain; tenderness severe over appendix	Nausea	99.4 84	Disten- tion; rigidity		*		Regular with pain and clots	o	Appendi- citis	Bright red with clots	Left ovary	Chronic
Adams (1913)	18	Three days before men- struation	Acute pain; tenderness in iliac fossas, particularly marked on right side	Vomiting		Rigidity					*	Appendi- citis	About 3 pints free blood; fluid and clots	Left ovary	*
Bookman (1914)	19	Seven days after men- struation	Sudden, se- vere, cramp- like pain	Vomiting	101.8 100	Muscular resistance		*			o	Appendi- citis	Bright red blood and clots	Right ovary	*
Lipscomb (1916)	25	Not men- tioned	Sudden, col- icky pain; tenderness particularly in right iliac fossa	Vomiting	99.4 100			*			*	Appendi- citis	One quart	Left ovary	o
Dansey (1916)	21	Not men- tioned	Sudden, a- cute, colicky pain; tender- ness acute in right iliac re- gion		100.8 120		From strain- ing at stool	*			o	Appendi- citis	Perito- neal cavity full of bright blood	Right and left ovaries	o
Browne (1916)	22	Not men- tioned	Tenderness in right iliac fossa	Profuse vomitus	High fever						o	Appendi- citis	Filled with thin, dark blood	Left ovary	*

CASES REVIEWED OF INTRA-ABDOMINAL HEMORRHAGE FROM RUPTURED CORPUS LUTEUM—(Continued)

Author	Age	Symptoms	Abdominal pain and tenderness	Nausea and vomiting	Temperature and pulse	Abdominal distention and rigidity	Sudden increase in abdominal pressure	Pallor	Blood findings	Normal menstrual history	Married	Pregnancy	Diagnosis before operation	Free blood in the abdomen	Ruptured corpus luteum	Complicated with appendicitis
Novak (1917)	15	Ten days after menstruation	Sudden pain, violent in right iliac fossa	Nausea; vomiting	100.2 138	Rigidity of right rectus muscle		*	Hemoglobin 45 per cent.; leucocytes 20,000; polymorphonuclears, 90 per cent.	*	0	Left tubal pregnancy, non-ruptured	Appendicitis	Large quantity	Ruptured follicular cyst, right ovary	0
Speese (1920)	20	Six days before menstruation	Sudden, severe pain	Vomiting			No trauma or strain	*	Leucocytes 18,850	*	*	0	Appendicitis	Much fresh blood and large clots	Right ovary	Chronic
Moore	29	During menstruation	Sudden knife-like pain in left lower abdomen; tenderness			No distention or rigidity				Regular, normal until last two months	*	1	Tubal pregnancy	Large amount	Right ovary	0
Moore	37	Seven days before menstruation	Sudden pain, excruciating about navel; 7.30 p. m. marked tenderness over McBurney's point	Nausea and vomiting after taking magnesia	98.7 84	4.30 p. m. no distention or rigidity; 7.30 p. m. rigidity				*	*	0	Appendicitis	Entire abdominal cavity filled with bright red blood	Right ovary	0

hemorrhage occurred two days before menstruation was due. His second case really should not be included in the tabulation, but it was used in order to draw especial attention to this interesting point.

If the menstrual history has been normal and if the patient has had previous intestinal disturbances simulating appendicitis, it is quite natural that a preoperative diagnosis of acute appendicitis should be made. This was the diagnosis made in my second case, while in the first, in which menstruation had been irregular, a diagnosis of ruptured ectopic pregnancy was made. As soon as the abdomen is opened and it is found to be filled with blood, the surgeon decides that the case is a ruptured tubal pregnancy. A rapid search, usually through a right rectus incision, fails to locate bleeding from either tube. Further examination shows the bleeding to be coming from the ovary. Sometimes the condition is complicated by the presence of acute or chronic appendicitis, but often the appendix is found to be normal.

Six of the fourteen tabulated cases were complicated by appendicitis. There may be some association between the two conditions, but what that association is has not been determined. It may be, as suggested by Primrose, that the follicle is ruptured by strain produced by a violent attack of vomiting.

The ovary should be considered an aggregation of follicles, some maturing and some retrogressing, constantly changing their appearance and function from day to day. The structures surrounding the different follicles also change, depending on the development and special function of the follicles. The ovarian stroma with its nerves and blood-vessels forms the framework for housing these follicles. Each follicle seems to have a life cycle of its own. All appear alike during their early development, but each month one gradually outstrips the others in growth and develops into a graafian follicle. Whether this follicle was always different from the others, or whether because of its richer blood supply it grows faster, is not known. At any rate, the ovum of this largest follicle, called the graafian follicle, is the only one which matures and when ripe is extruded. As soon as this takes place, there is no further growth of the other follicles which started to mature; their ova die and gradually disappear, leaving the so-called atretic follicles. Only one ovum goes to maturity each month. Following the giving off of the ovum great changes occur in the graafian follicle, producing what is known as the corpus luteum.

The blood supply of the graafian follicle and of the corpus luteum has been worked out so thoroughly by Novak,⁹ from a study of a large number of ovarian sections, that my statements have been obtained from his writings. The maturing follicle, it appears, receives its blood supply from vessels in the theca interna, from which tiny offshoots penetrate into the granulosa. The earliest stages of the corpus luteum are marked by a great increase in the number and size of these vessels in the theca and also at the base of the granulosa. This fact is of particular interest, since it seems to indicate that, due to the stage of hyperæmia which follows the extrusion of the ovum,

hemorrhage can occur more readily into a corpus luteum than into a graafian follicle.

To the physician who has not actually seen an abdomen filled with blood exactly as it is found during a ruptured ectopic pregnancy, it does not seem possible that such extensive hemorrhage could come from the tiny vessels which encircle the follicles. That this is actually what does occur occasionally has been observed sufficiently often by a number of surgeons, who have not only seen the hemorrhage coming from a ruptured ovary, but also have removed either the entire ovary or a portion of it, to prove microscopically that the bleeding originated either from a ruptured graafian or atretic follicle or from a ruptured corpus luteum.

Penny's¹⁰ case proves that hemorrhage of this kind can terminate fatally. His patient, a healthy woman, mother of two children, was taken ill at 7 P.M. She was menstruating at the time and attributed her symptoms to this fact. She gradually grew worse and died shortly before 4 A.M., having been ill less than nine hours. Necropsy showed a large amount of dark fluid blood in the abdominal cavity, the right side especially being full of fluid and semicoagulated blood. In the right iliac fossa was a rather firm blood clot which led to the right ovary to which a firm clot 2.5 cm. long was attached. There were two ruptured graafian follicles, to one of which an ovum was adherent.

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PREMATURE OSSIFICATION AFTER SEPARATION OF THE LOWER RADIAL EPIPHYSIS

BY MORRIS K. SMITH, M.D.

OF NEW YORK, N. Y.

T. B., a boy of seventeen, applied at the Out-patient Department of St. Luke's Hospital in May, 1919, with a traumatic separation of the left lower radial epiphysis, at first thought to be a Colles's fracture. There was backward displacement of the epiphysis carrying with it a thin shell of bone from the posterior surface of the diaphysis, as so often happens in this type of injury (Fig. 1). The ulnar styloid was also broken. The displacement was treated by reduction under gas anæsthesia and the patient ultimately discharged, the result being considered fair. About eight months later he returned complaining of prominence of the head of the ulna on the injured side and weakness and pain in the wrist. An X-ray made at this time showed some obliteration of the radial epiphysial line (Fig. 2). At the end of a year from the date of injury further X-rays were made. At this time there was complete ossification of the radial epiphysis while that of the ulna had largely disappeared (Fig. 3).

At the most recent examination, over two years from the time of injury, the patient stated that he had good use of his wrist. The head of the ulna was prominent. The radius measured three-quarters inch less than that on the uninjured side and the total length of the forearm from olecranon to tip of middle finger was three-quarters inch less than its fellow. There was no difference in the length of the two ulnæ.

The interest in this case lies in the clear radiographic demonstration of premature ossification of the previously separated epiphysis, resulting in arrested growth. The process in the radius was observable in eight months and complete in one year. Another feature of interest is the accompanying ossification in the ulna epiphysis, although the original injury here was a fractured styloid.

Traumatic separation of the epiphysis is a fairly frequent type of injury and may be mistaken for ordinary fracture. The prognosis should be guarded in all such cases on account of the possibility of arrested growth. It is impossible to tell from the clinical and radiographic evidence of the injury when it is to be expected. It has occurred when there has been no displacement.

I have not been able to find any data as to the exact frequency of arrested growth after epiphysial separation beyond the fact that it is rare. Poland¹ in his exhaustive study collected fifty-six cases of arrest of development, of which seventeen were at the lower end of the radius. Stimson² states that a few such cases have been reported and mentions two personally observed

in which injury at the lower end of the radius at the age of fourteen years produced a late deformity exactly resembling that of a bad Colles's fracture. Pilcher³ reported a case of arrested growth in a man whose wrist he had originally reduced twenty years before. Tanton⁴ described a case of arrested growth at the lower end of the radius and quoted Walter, Chaput and Lorenz as having reported similar cases. Others who have mentioned such cases include Andrews⁵ and Murphy.⁶

SUMMARY

Traumatic separations of the epiphyses are not uncommon, among the most frequent being that of the lower end of the radius. Arrest of development following this injury sometimes occurs, although reported cases are not numerous. In the case described the premature ossification was evident radiographically in eight months and complete in one year.

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FIG. 1.—Traumatic separation of lower radial epiphysis carrying with it a thin shell of bone from the posterior surface of the diaphysis.



FIG. 2.—Eight months after injury, there is partial obliteration of radial epiphyseal line.



FIG. 3.—One year after injury. Lower radial epiphysis is completely ossified while that of the ulna is largely so.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Joint Meeting with the New York Surgical Society held November 7, 1921

The President, DR. GEORGE G. ROSS, in the Chair

DRAINAGE

DR. JOSEPH A. BLAKE, of New York, read a paper with the above title, for which see page 385.

THE PRESENT STATUS OF EPIPLOPEXY

DRS. JOHN H. GIBBON and JOHN B. FLICK, of Philadelphia, read a paper with the above title, for which see page 449.

REGENERATION OF LOWER JAW

DR. ROBERT H. IVY presented a little girl, aged seven, who was first seen in January, 1921, suffering from osteomyelitis of the lower jaw originating in dental infection, with complete sequestration extending from the first permanent molar on the right side to the canine region of the left side. Removal of the sequestrum was required, leaving a separation of about an inch and a half between the remaining portions of the mandible. Doctor Ivy showed her especially to demonstrate the complete regeneration of bone which had occurred since that time. The X-ray in October showed complete regeneration of the bone and restoration of continuity. There was also exhibited a wire splint made by Dr. John Ross, cemented to the molar teeth on each side, by which the full width of the lateral halves of the jaw was preserved during the process of regeneration, with resulting excellent occlusal relationship between the remaining lower and upper teeth.

CICATRICIAL ANKYLOSIS OF THE JAW

DR. JOHN H. JOPSON and DR. ROBERT H. IVY presented a colored girl, aged twenty-three, who at the age of eight, she states, had typhoid fever which caused ulceration of the cheek and resulted in adhesion of the inside of the cheek to the lower jaw, producing inability to separate the upper and lower teeth. She came to the Polyclinic Hospital the beginning of September with inability to separate the incisor teeth more than one mm. A knife blade could not be passed through. Wassermann reaction was negative although she said she had received injections for "bad blood" two or three years previously. At operation it was found that adhesions held the mucous membrane of the cheek to the lower jaw. By cutting the adhesions back as far as the ascending ramus it became possible to get the jaw open about three cm.

The jaw was kept blocked open with a wooden wedge attached with wire between the teeth on the left side. To cover the raw surface of the inside of the cheek, a flap of skin was raised from the right side of the neck with its pedicle about the region of the mental foramen and extended back toward the mastoid process. This flap was inserted into the mouth through a buttonhole incision in the lower vestibule and sutured to cover as much of the raw surface as possible. A few weeks later under local anæsthesia the connection with the outside skin was severed. While the result is not perfect and there is some recurrence of the contraction, the patient is now able to masticate solid food. The operation is being supplemented by the use of a home-made wooden wedge which the patient uses herself.

END RESULTS OF OPERATION FOR DUPUYTREN'S CONTRACTURE

DR. ARTHUR BRUCE GILL said that in the *ANNALS OF SURGERY* of August, 1919, he published a description of a method of operation for the cure of Dupuytren's contracture and reported one case operated upon by the method described.

Briefly, this operation consists of : first, an incision in the palm along the line of the distal palmar crease ; second, a complete excision of the palmar fascia from the webs of the fingers to the base of the palm through this incision ; third, the insertion beneath the skin of a free fat transplant from the thigh. If the fascia on the palmar aspect of the proximal phalanges is contracted it should be excised through transverse incisions along the creases at the bases of the fingers. If the proximal interphalangeal joint of a finger cannot be extended after such excision of fascia the head of the proximal phalanx should be excised through a transverse posterior incision over the joint.

The case which he reported at that time he now presented again. The operation on his hand was performed three years ago. He has worked steadily ever since. The scar of the incision is almost invisible, the palm of the hand is soft and normal to appearance and touch, and there has been absolutely no return of the former contracture. But it is interesting to observe that there is some contracture of the fascia of the thenar eminence. This portion of the palmar fascia was not excised at the operation because it was not then contracted. It should now be removed through an incision following the crease around the base of the thumb.

He then presented two other cases :

CASE II.—W. J. He was operated on for Dupuytren's contracture of the left hand in October, 1919. Contracture had been present for five years. The little finger was flexed tightly into the palma. The ring and middle fingers were moderately flexed. The operation was performed as described. It included excision of the fascia on the palmar aspect of the fingers and the excision of the head of the proximal phalanx of the little finger. The skin of the palm of the hand along the line of the distal palmar crease was considerably macerated

owing to the long-continued extreme contracture. Because of this condition the wound opened up slightly after the operation. There was serous discharge for a period of three or four weeks, but no sloughing of the fat transplant. As in case number one the result is entirely satisfactory; the scar is scarcely visible, the hand is absolutely free of contracture, the palm is soft and pliable. The little finger is straight but there is a fibrous ankylosis at the proximal interphalangeal joint. This, however, does not interfere in the least with his usual work as a laboring man, whereas the contracture of the finger formerly prevented his holding tools and annoyed him greatly.

CASE III.—J. B. This patient is presented through the courtesy of Dr. A. P. C. Ashhurst, under whose care he has been. In October, 1916, both hands were operated upon by the Adams method of multiple subcutaneous tenotomies of all the contracted bands of fascia. At that time he was thirty-nine years of age. For eight months he had had Dupuytren's contracture of both hands, the third, fourth and fifth fingers being involved, and the fifth finger being flexed completely into the palm. He was employed in a lead factory and his fingers were constantly flexed when at work.

Following the operation he wore gypsum splints continuously for six weeks and then only at night for six weeks more. Following this he had massage three times a week for several weeks. The left hand was improved by the operation while the right hand was not so useful as it had been before. In the latter the only use was of the thumb and index finger. The other fingers remained still in extension. In the left hand the third, fourth and fifth fingers had slight active flexion. In November of 1920 his left hand had relapsed and become very much worse even than the right. November 23, 1920, operation was done by Doctor Ashhurst after the method which the speaker had advocated. At the end of a year both his hands are free of contractures, palmar tissues are soft and pliable, and the scars are scarcely apparent. The interphalangeal joints, however, are more or less rigid. This latter condition illustrates one of the disadvantages of the Adams procedure. The splinting which is necessary after the subcutaneous tenotomies not infrequently leads to fibrous ankylosis of the fingers. After the operation now described a palmar splint is applied, which extends only to the base of the fingers, for a week or ten days. This allows free use of the fingers during this period. As soon as the hand is healed the patient is allowed to return to his usual work.

It is evident that the operation in these three cases has been eminently satisfactory. It seems reasonable to believe that in this method of operation we have a complete solution of this troublesome condition. The fibrous ankylosis of the finger in case two he had seen occur in other instances following the excision of a portion of the phalanx, to relieve a long-continued contracture of the interphalangeal joint. In one case of ankylosis of the finger he had inserted a free fat transplant following the excision of a portion of the phalanx. This case when last seen had motion present in the joint.

DR. JOHN H. GIBBON stated that since hearing Doctor Gill's first report on this condition some time ago, he had operated upon a case by this method with most satisfactory results. He believed that the old method with the longitudinal incisions is not comparable to this.

DR. JAMES T. RUGH reported that he had had two more cases of the same type, operated on in the same manner with excellent results, far superior to the old time operation.

Stated Meeting Held December 5, 1921

The President, DR. GEORGE G. ROSS, in the Chair

LANTERN DEMONSTRATION OF CYSTIC DISEASES OF BONE
AND BONE TUMORS

DR. RALPH S. BROMER (by invitation) presented a series of lantern slides illustrating the röntgenologic diagnosis of cystic diseases of bone and bone tumors.

DR. ASTLEY P. C. ASHHURST presented a series of lantern slides illustrating the clinical diagnosis, prognosis and treatment of cystic diseases of bone and bone tumors.

DR. C. Y. WHITE (by invitation) presented a series of lantern slides showing microphotographs of cystic diseases of bone sarcoma and discussed the pathological diagnosis.

THE CAUSE OF DEATH IN HIGH INTESTINAL OBSTRUCTION

DR. J. W. ELLIS, of the Medical Corps of the U. S. Navy, read a paper with the above title, for which see page 429.

EXTERNAL BILIARY FISTULA

DR. JOHN H. JOPSON and DR. JOHN SPEESE reported a case of obstruction of the common bile duct with complete external biliary fistula, relieved by choledochogastrostomy.

The patient, a male about forty-five years old, was admitted to the Presbyterian Hospital in October, 1920, suffering from an acute upper abdominal inflammation of one week's duration, accompanied by chills, fever and deep jaundice. Two days later he was operated upon by Doctor Speese, and a perforated gall-bladder containing a number of small stones was drained. Bile and calculi were found outside the gall-bladder. A biliary fistula persisted, and six weeks later a second operation was performed to effect its closure. No stones had been found in the common duct at the first operation, but the stools remained clay colored and an obstruction was evidently present. At the second operation, which was very difficult by reason of the extensive adhesions present, the gall-bladder was found to be almost entirely sloughed away. With difficulty the common duct was located, and it was thought that a probe could be passed into the duodenum. A tube was inserted into the duct, and the wound was partially closed. No improvement resulted, and four weeks later another operation for the relief of the obstruction and cure of the fistula was attempted. The same difficulties were

encountered in the recognition of structures, due to the dense and massive adhesions. When the duct was uncovered it was found to be obliterated in its lower portion. It seemed impossible to expose the duodenum sufficiently to establish a communication with the duct, and as the pylorus was accessible and in close proximity, a fistula between it and the upper portion of the common duct was constructed. A piece of Dakin tubing was passed into a lateral opening in the duct, sutured to its margin, and the other end was introduced into the stomach, the walls of which were tacked to the duct by sutures in front of and behind the opening. The technic was similar to that sometimes employed in choledochoduodenostomy. Leakage of bile in diminishing amount persisted from the wound for a time, soon became scanty, and after several weeks the wound closed, and has remained healed. Bile reappeared in the stools after twelve days. For a time the patient had recurrent attacks of pain and jaundice, evidently associated with cholangitis, but these have ceased, and he is now in good condition.

The operation of anastomosing the common duct to the duodenum has been performed many times, where obstruction was present which could not be removed; also where reconstruction by plastic operation was impossible in cases where the duct had been accidentally wounded or mutilated, or where it had been deliberately resected. In the latter cases an external biliary fistula, with its attendant disabilities and dangers, threatens or is already established. While the operation may be difficult, involving as it does the exposure of the upper portion of the common duct, or of the hepatic duct, in a mass of adhesions in the old cases, and its approximation and suture to the near-lying duodenum, such terminal or lateral approximation can usually be accomplished. In this case operated by us, it was impracticable by reason of the adhesions burying the duodenum, and the anastomosis to the pyloric end of the stomach proved eminently satisfactory.*

LYMPHOSARCOMA

DR. J. RALSTON WELLS, from the service of W. Estell Lee, M.D., at the Children's Hospital, Philadelphia, Pa., reported the history of a boy, nine and one-half years of age, who was admitted to the hospital August 8, 1921, on account of a lump in his left axilla. Approximately one year ago he began to have boils over the body and arms. No history of any specially chronic ones at seat of present lump (mass). About seven months ago first noticed a swelling in the left axilla. At this time it was about the size of an ordinary marble. This lump, as time went on, gradually increased in size, although without treatment at times seemed to become smaller for a week or so and again resume its progressive enlargement. Three weeks ago two spots appeared near the apex of the rounded mass and showed a tendency to ulcerate. During the last

* Since reporting this case Dr. Ellsworth Eliot has called their attention to the statistics collected by him in his article "The Repair and Reconstruction of the Hepatic and Common Bile Ducts," read before The American Surgical Association in 1917, in which six cases are mentioned as treated by this method of choledochogastrostomy, at least five of which were successful.

week the lump has increased very rapidly in size, one of the above-mentioned spots has broken the skin, forming an ulcer which has a serous, slightly odorous discharge. A few darting pains have been present in the mass during the last few weeks. Patient unable to define the direction the pains radiated. Pains have never been severe or prolonged over several seconds. Usual diseases of early childhood, otherwise has been "very well." Family are well, no history of tuberculosis or neoplasm. The patient is a white boy. Well developed, well nourished, good color, and apparently in good health. Facial expression good; skin of good color and texture, warm and normally moist. No rash or other abnormal qualities noted.

The left anterior axillary, upper part, is the seat of a relatively large indurated swelling approximately six cm. in diameter at the base, and four cm. from base to apex (apices). This mass terminates in two tit-like formations, dark purple in color, one is ulcerated, the other apparently contains fluid, two to three c.c., and is apparently covered with a very thin skin. The ulcerated tit is the seat of an excessive granulation which is flattened over a small part of the skin surface, therefore of rather a pedunculated structure; this measures approximately one cm. at the base and two and one-quarter cm. across its surface. An area of induration extends from mid-axilla to mid-clavicular lines and up almost to the clavicle and below to the nipple line. The growth is apparently attached to the skin but moves freely, *en masse*, on its underlying structures. There is apparently no pain on palpation, the ulceration is painless, the entire mass is resistant in firmness but not hard. No pulsations are felt, but in places a distinct bruit is heard per stethoscope.

The supra- and infra-clavicular glands are somewhat enlarged on this side but not painful to palpation, and apparently *not* the seat of a very acute *inflammatory* process. The same region on the right side is negative, grossly.

The lungs are normal except over the outer infra-clavicular region, left side, in which area the resonance is impaired.

The left arm has a small mass in the upper third which is apparently composed of granulation tissue, approximately one and one-quarter cm. in diameter, flattened and closely simulating the tissue seen on the one ulcerated peak of the growth. Tissue is friable and bleeds slightly. The left axillary glands are enlarged. Supra-clavicle, left enlarged and one fairly discrete nodule is felt. Infra-clavicle, left enlarged, right axillary, supra- and infra-clavicular (epitrochlears), bilateral and inguinals (bilateral), are apparently normal.

On August 9, 1921, the growth was removed, together with the breast and underlying muscles, adopting the usual technic of a breast-cancer operation.

X-ray examination showed no signs of secondary bone involvement or any involvement of the lungs. The mediastinal shadow shows no enlargements.

The laboratory examination of the tumor removed. The specimens consisted of one large mass measuring twenty by six cm. at the base

PRIMARY AXILLARY LYMPHOSARCOMA IN A CHILD

and five cm. thick, and numerous small masses, for the most part lymphatic glands, of varying size. Main mass is moderately firm, the upper two-thirds covered with skin, the base is apparently covered on the under surface for the most part with a more or less formed membrane of connective tissue. Some muscle tissue is attached to the base edges. The upper surface of the mass has two projections, one apparently ulcerated and one a ruptured cystic formation. Color, blue-black. Cut surface is red and more or less smooth lobulations are lightly marked, numerous large vessels transverse in all directions. The surface directly under the dark projections is purple in color and run into the tumor in the shape of a cone or infarct (tip in). The small glands are hard, glistening and more or less friable (cut), with slightly increased resistance. Microscopic: Large round-cell sarcoma (alveolar). Glands show metastatic involvement.

The case made an uneventful recovery, gained weight and was apparently in good health on discharge. Was referred to the outpatient department for treatment by X-ray and the mixed toxins of Coley. This toxine treatment has been pursued with weekly injections to the present time. Examination within the last three days shows the left supra-clavicular space to be more full than previously noted. This change is recent, the space mentioned has always been somewhat full, but at present is more so, and two enlarged glands are easily palpated. Mother states that he is apparently normal.

PRIMARY AXILLARY LYMPHOSARCOMA IN A CHILD

DR. J. RALSTON WELLS said, in studying this case of primary lymphosarcoma, alveolar in type, of the axillary lymphatics, he found that it was either of a relatively uncommon occurrence or else the reports in our literature for the last decade were not representative of its frequency.

A very brief résumé of this type of growth and its possible derivation, or better, theories as to its derivation, may not be amiss at this point.

Up to comparatively recent times all neoplasms were classed as cancer, but Virchow, approximately sixty years ago, first called attention to and designated sarcoma as a distinct group in this atypical growth of living tissue.¹

Senn² defines sarcoma as "an atypical proliferation of connective-tissue cells from a matrix of fibroblasts of congenital or post-natal origin. . . . Connective tissue the sole origin of sarcoma . . . other tissues involved by extension. The intimate relations of the new blood-vessels with the parenchyma of the tumor is the characteristic feature of sarcoma. The more recent definition of Ewing³ corresponds to that of Senn. "Sarcoma is a malignant tumor composed of cells of the connective-tissue type." This classification which in its basic points is clear, does not include a large number of tumors whose origin is questionable or whose structure is not typical and thus a border-line or transitional group of tumors are found. Ewing says that "Diseases such as angiosarcoma, lymphosarcoma and gliosarcoma are of such varied origin and character that some writers have urged the elimination of the term sarcoma. . . . The finer analysis of the origin and composition of many sar-

comas reveals a prominent participation of endothelium in many tumors of distinct mesoblastic characters. In such cases the characters of the tumor cells rather than their embryonal antecedents should determine the classification."

Lymphosarcoma is a true sarcoma, but it is also open to doubt in many border-line cases. Tracing this group, let us start from the purely benign lymphomata through the leukemias with their characteristic blood pictures, and pause a moment at Hodgkin's disease. This condition is relatively well defined, but its various gradations and locations very often lead us by logical sequence through Hodgkin's granuloma to Hodgkin's sarcoma and from this to true lymphosarcoma. Recorded cases of a seeming transition are found. Several striking examples by careful observers may be cited. A report by Welch,⁴ in which he originally found Hodgkin's granuloma in a cervical lymph-gland, and some months later at autopsy, tumor masses resembling sarcoma were removed from the neck, dura, liver, etc.; another similar case by Karsner,⁵ the following by Coley⁶ in which a primary diagnosis of simple lymphoma was made (neck), seven months later a diagnosis of sarcoma. A true differentiation may be made between these border-line cases only when the relatively slight tendency to invade the surrounding tissues and the origin are taken into consideration.

The origin of sarcoma is one that has not been satisfactorily established, and it is not my purpose to enter into a lengthy discussion in this brief outline. True uncomplicated lymphosarcoma, localized or diffuse, is rapid in growth, and little, aside from the typical history and microscopic findings, are possible to determine theories of rests, inclusions, and undifferentiated cell groups. Occasionally a case of perhaps slower growth or a striking example of a particular type may be found, and these theories are not to be lightly laid aside, many appearing reasonable for specific cases; but in a large number of cases seen in the allied or borderline cases of Hodgkin's granuloma and sarcoma, and true lymphosarcoma, an irritant such as the tubercle bacillus or other like foreign agent seems to be a well-established origin.^{7, 8} Whether a bacillus or other irritant starts the process, and this process then proceeds under its own momentum, or whether, as may be at times in the case of the tubercle bacillus, the bacillus breaks up into a granular formation and continues its activity in this state, is of no special consequence; the point is that a definite sarcoma, originating in lymphatic tissue, is found after passing through its "transitional" (possibly Hodgkin's granuloma) changes.⁸ The exciting causes being bacillary or toxic irritation, repeated trauma, direct implantation, infection or transmission, with or without previous congenital inclusions. This may be more prevalent than has been realized. Many other explanations may be, and are possible, but at least this theory will be answerable for a definite number.^{9, 10, 11, 12, 13}

Kundrat¹⁴ separated definitely a type or class of lymphosarcoma from the general group of pseudo-leukæmia and leukæmia. This classification only holds for those that extend by definite lymph chains and channels. We know that true metastases does occur in lymphosarcoma other than by means of

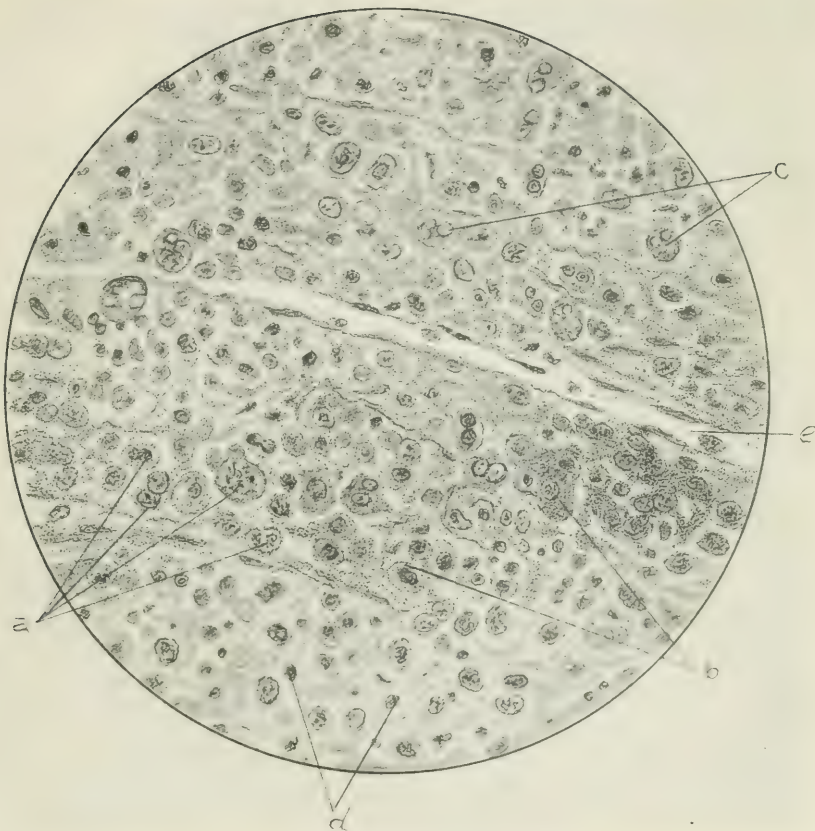


FIG. 1.—One microscopic field, not a composite drawing. a. Mitotic figures and division. b. Alveolar groupings. c. Vacuolated neuculi d. Round cells. e. Capillary showing thin single celled wall.

the lymphatics, however Kundrat's group, he claims, is not to be confounded with the true neoplasms, although it is "one of the most malignant of diseases." Because this type of growth closely resembles pseudo-leukæmia, and that from the latter true lymphosarcoma may arise, we may infer a very close relationship to sarcoma, especially in view of the fact that we know of other changes of type.

Ewing states that there are two distinct forms of lymphosarcoma, namely: (1) Reticulum-cell sarcoma or large round-cell lymphosarcoma, and (2) malignant lymphosarcoma, (a) originating from the reticulum cell; . . . (b) from the lymphocyte. But "until the relation of the lymphocyte to the reticulum cell is fully established, the two conditions may be discussed together." Thus we see that the large class of lymphosarcoma is constantly changing as new findings are made; through the studies of many of our investigators, divisions and subdivisions are formed and as yet no classifications includes all established forms, even if the so-called borderline or transitional types were not taken into account.

As to the age incident, sarcoma is generally considered a disease of early life. This is true especially when contrasted to carcinoma, but it is also a disease of middle and advanced life. Therefore we must think of it as a disease of all periods of the life cycle.¹⁵ It is interesting to note the age incidence of carcinoma and sarcoma; sarcoma occurs at an earlier age in the young than carcinoma, but both curves almost coincide from the ages twenty-eight to thirty-two up through age period forty-eight to fifty-two.

The most common seats of primary lymphosarcoma are (1) cervical (including the tonsils), (2) axillary, (3) inguinal, and (4) the retroperitoneal and mediastinal glands. The report of the sarcomas of the lymphatic glands (primary neoplasma of the lymphatic glands) by Coley⁶ would lead one to think that the disease was more common than our investigations apparently show, but in this report we are hearing from a master surgeon in this particular field, and it is his exceptional opportunity to see a large number of this particular class of patients. His reports cover a period of twenty years up to 1915 and include cases of other surgeons' reports. The neck; neck and tonsils 103, other surgeons 22, total, 125; axilla 18, other surgeons 1; inguinal 17, other surgeons 2; retroperitoneal and mesenteric 10, other surgeons 12; mediastinal 1, other surgeons 0. An accompanying report of Hodgkin's comprises twenty-one cases. Investigation for a like number of years, 1902 to present, show in two large general hospitals; Hospital of the University of Pennsylvania a total of twenty-three cases of true lymphosarcoma (neck 14, axilla 3, inguinal 1, all others 5); Philadelphia General Hospital a total of seven recorded.

For the privilege of operating upon this case and reporting it, he was indebted to Dr. W. E. Lee, on whose service in the Children's Hospital of Philadelphia the case was admitted and treated. At the time of this report the case is still under treatment.

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ANOMALOUS ABDOMINAL MEMBRANES* THEIR INFLUENCE UPON THE DIGESTIVE TRACT

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BECAUSE of the tediousness of an attempt at detailed discussion of the many complexities, anatomical, pathological, and symptomatic, associated with this subject, it has seemed best to present the general considerations for discussion at this time, reserving for more complete presentation, in later communications, the different groups involved. No attempt is made to follow the chronological history of the development of the subject, nor to present a complete bibliography, nor to claim any priority or originality in the matter.

This paper is based upon a series of personal cases operated upon since 1914, of which the first fifty are taken because sufficient time has elapsed to get an idea of end-results.

The membranes encountered in this series were in the following groups: (1) Hepato-duodenal and hepato-duodeno-colic. (2) Duodeno-jejunal. (3) Jackson's membrane, or pericolic membrane. Associated with this last were certain anomalies of the omentum in a small percentage of the cases, and a chronic appendicitis in many cases. Any one, any two, or the entire combination may appear in the individual patient. In a considerable number the appendix had already been removed without relief, so that post-operative adhesions were added to the pathological picture. Scattered irregularly through the series have been occasional complications such as ulcer, biliary calculi, cholecystitis, perihepatitis, pelvic disturbances, etc.

The *hepato-duodenal*, and its modification, the *hepato-duodeno-colic* membrane, runs from the cystic duct and a greater or less portion of the gall-bladder, down to the first portion of the duodenum, running from the apex toward, and often as far as, the pylorus. When there is a colic part to the membrane, it is usually a continuation downward from the duodenum and pylorus to the beginning of the transverse colon. This membrane is nearly always made up of two distinct leaves, just as is the mesentery of the intestine. Usually it is thin and transparent, just as is the peritoneum. There is seldom much vascularity in the membrane. In the majority of instances the membrane involves from one-third to one-half of the lower

* Read before the New York Surgical Society, January 25, 1922.

border of the gall-bladder. In a few cases it extends outward to the fundus and in at least two instances a double membrane extended from 1 to 2 cm. beyond the fundus, and was continuous with the peritoneal covering of the liver. In certain instances the membrane is very narrow and involves only the cystic duct. It extends to the first portion of the duodenum and often to the pylorus. Most of the illustrations, which have appeared in various articles on this subject, have shown these membranes going down to the duodenum, usually with the portion going from the cystic duct reaching the duodenum toward the pylorus, and the outer edge of the membrane running from the under surface of the gall-bladder to the apex of the duodenum. This gives a different picture from that which has been seen in this present series of cases, in which, in every instance where the membrane was sufficiently well developed, the portion running from the cystic duct went directly to the apex (the junction of the first and second portions of duodenum) of the duodenum, and then extended out upon the gall-bladder toward the fundus and down upon the first portion of duodenum toward the pylorus, so that the free edge extends from the under surface of the gall-bladder to the duodenum near or at the pylorus.

In a number of instances the pylorus and beginning duodenum have been directly in contact with the fundus of the gall-bladder, and the first portion of the duodenum has then run along the gall-bladder to the cystic duct. The membrane has then consisted of a fold running on each side directly from the gall-bladder to the duodenum with unperitonealized surfaces at least 1 cm. wide between the duodenum and gall-bladder.

In addition to these peritoneal membranes, there have, in a few instances, been entirely separate cicatricial adhesions running from the duodenum to the under surface of the liver, either just to the right or just to the left of the cystic duct. In certain cases, without there having been any anomalous membrane, the gastrohepatic omentum has been unusually short, and its free edge quite thickened and rigid has extended somewhat to the right so that the apex of the duodenum has been elevated, firmly fixed and angulated. In two cases (VI and XXII) the membrane was so situated about the cystic duct as to cause a constriction and a sharp angulation with symptoms of biliary colic which will be referred to later. In one case (of a later series) the duct was given a double angulation by the drag downward of this membrane. Extension of the membrane to the colon often causes high fixation with angulation or constriction, or both, and usually fastens the pylorus or the antrum and the transverse colon closely together so that the overfilling of either one interferes with the function of the other.

This membrane acts to interfere with the digestive function in several ways. The apex of the duodenum is practically always fixed at an unusually high level beneath the liver and is also dragged distinctly backward. It is usually rather firmly held in one position with only slight mobility. The membrane often reaches across the front of the duodenum in such a way as to cause compressions and kinking in addition to the high fixation. In

several cases where the membrane reached from the apex of the duodenum downward obliquely across the front of its first portion to the lower edge of the pylorus, there was added torsion, on its long axis, of the first portion of the duodenum. Further, in many cases, if the membrane runs well out upon the gall-bladder, it reaches the first portion of the duodenum after passing across the front of the descending duodenum so that in this way there is added a certain amount of compression of the descending duodenum.

In these cases where the stomach has gradually dilated in consequence of the continuous partial obstruction to its proper evacuation, the pyloric end of the stomach will be pushed over well to the right of the mid-line and then because of the fixed position of the first part of the duodenum it bends sharply backward, inward and upward. This adds kinking in the pyloric antrum which also adds to interference with gastric function. This angulation of the antrum has been repeatedly demonstrated upon the operating table. When the obstruction has continued long enough, the stomach becomes considerably dilated and we have the perfectly typical ptosed fish-hook type of stomach, in which the first portion of the duodenum will not infrequently be elongated because of the downward drag of the stomach on the fixed apex of the duodenum.

Anomalous membranes about the duodeno-jejunal angle are quite variable and can hardly be put into groups or classes. In some cases the ligament of Treitz is anomalous; it extends upward and to the left and pulls the angle far upward and outward—causes sharp compression from extending over its anterior surface, and causes sharp angulation because of its high elevation. This has several times been the cause of marked obstruction with resultant great dilation of the dependent duodenum.

In one instance the beginning jejunum curved from the "angle" in front and over to the right of the superior mesenteric vessels where a double fold of thin, transparent peritoneum ran upward and to the right, fusing with the inferior mesocolon, and then the jejunum ran sharply to the left again. This made a regular Z-shaped, double-kinked deformity resulting in serious interference with the function of the duodenum.

In a number of instances the peritoneum in front of the superior mesenteric vessels has been very considerably thickened and in two instances there have been small calcified lymph-glands in the same situation.

At this point one should at least mention certain other forms of duodenal obstruction, although they are not the result of these anomalous peritoneal membrane formations. These other types of obstruction have been well described by Kellogg and have to do with obstructions from the mesenteric vessels and certain kinkings and adhesions retroperitoneally. In one of the cases, following this series of fifty, there was distinct constriction of the descending duodenum by fibrous tissue in the transverse mesocolon where the duodenum passed behind it.

The result of these anomalous membrane formations, as well as other types of obstruction, is to cause marked dilation of the duodenum proximal

to the obstruction. There is, of course, great interference with the proper function of the duodenum with resulting symptomatology later to be mentioned.

Jackson's membrane, or *pericolic membrane*, is another of the very atypical, anomalous membranes. It would perhaps be better to call these membranes by the term pericolic, inasmuch as Doctor Jackson objects that many men are reporting cases under the title of "Jackson's Membrane" which are not truly such. The term, "Jackson's Membrane," has been used in the records of these cases to indicate membranous formation running from the outer side of the cæcum and ascending colon up to and across these portions of the gut. The most extensive membranes involve the cæcum and ascending colon up to and including the hepatic flexure. On the other hand, there may be present merely a small, narrow band of membrane located either at the hepatic flexure or, more commonly, about the middle of the ascending colon, or in relation to the beginning ascending colon just above the cæcum. Between these limits there may be any variation as to the extent and development of these membranes. They may be sufficiently loose so that they pass in front of the gut like a loose, superficial veil, which has no influence whatever upon the functioning of the gut. On the other hand, the membrane may be so thickened, so short and so placed as to cause very serious distortion, compression and kinking of the lumen of the gut. In the well-developed, extensive membrane, there may be areas of thickening which cause distortion and compression of the gut at the place where they are situated, while the major portion of the membrane may be exerting no disturbing influence. The thickenings in such membranes are most apt to be situated at the hepatic flexure, at the middle of the ascending colon, and at the beginning of the ascending colon. Frequently the thickenings at the hepatic flexure and beginning of ascending colon are at the edges, upper and lower, of the membrane, while there is very frequently a third thickened band at about the middle of the membrane, running across the middle of the ascending colon. Usually the upper edge of such extensive membrane runs obliquely from above downward and inward, arising from parietal peritoneum just above right edge of liver, while the lower edge, as a rule, runs obliquely from below upward and inward, the membrane thus being somewhat fan-shaped with the spread of the fan along the right flank, where it is fused with the parietal peritoneum. These membranes usually can be slipped freely over the true peritoneal coat of the gut. They mostly fuse with the peritoneum of the gut along its anterior convexity, but may cross it and fuse with the inner mesocolon. Sometimes they are somewhat thinner than normal peritoneum and show many fine blood-vessels which run transversely to the long axis of the gut. The origin of the membrane from the right flank is practically always upon a level with the posterior wall of the gut so that in passing across in front of the gut it necessarily goes well forward and then inward. When the bands associated with the membrane begin to

shorten, it is readily understood how the intestine must be compressed and kinked and distorted.

Another anomalous formation is occasionally seen in the distribution of the great omentum. Instead of its right border being situated slightly to the left of the hepatic flexure, the origin of the omentum passes around the hepatic flexure and down the front of the ascending colon for a variable distance. The effect of this unusual distribution of the omentum is nearly always to firmly fix together the ascending colon and beginning of transverse colon so that they are in immediate contact, frequently to a point down to the middle of the ascending colon and occasionally even down to the upper end of cæcum. The effect of this distribution is to cause a sharp angulation at the hepatic flexure and to cause interference with the proper peristalsis of both limbs of the gut. Another modification of this type of omental anomaly is that in which the right edge of the omentum passes obliquely downward and to the right across the beginning of ascending colon, or upper end of cæcum, and becomes fused with the parietal peritoneum on the outer side of the gut, or becomes fused with, or adherent to, a true pericolic membrane.

Another element often related to the etiology of the symptoms in these cases is the circumstance of adhesions between the omentum and the operative scars which have been made in a more or less vertical direction through the abdominal wall, for many of these patients have been subjected to appendectomy or exploration without benefit. Where these adhesions have become somewhat thick and firm, the transverse colon is usually pulled downward, and not infrequently the adherent omentum passes obliquely across the ascending colon, or cæcum, and causes interference with its function either by pressure or by adhesions to the gut. The effect of these anomalous membranes, whether by distortion, angulation or compression, is to interfere with the proper peristaltic progress. There results a stasis in the cæcum and part of the ascending colon with the natural result of fermentation occurring in the gut contents. After a time the cæcum begins to dilate and to lose its strength, the ileocæcal valve may become incompetent and ileac stasis and regurgitation through the ileocæcal valve result; also after a time the appendix begins to give symptoms of irritation which, to my mind, are the result of this gradual distention of cæcum, resulting in back pressure, which interferes with the proper emptying of the appendix. Also the fermentation in the cæcum is apt to cause irritation, both to its own mucous membrane and to that of the appendix.

The experience with this whole group of cases has led to the conviction that many of the so-called chronic appendices are the result of disturbances of just this type. If this be so, the failure of appendectomy to cure, in a high percentage of cases of so-called chronic appendicitis, is readily explained because the removal of the appendix does not deal with the essential causative factor of the trouble, the appendix itself being involved only secondarily in the development of this condition.

Concerning the derivation of these anomalous membranes, there has been

much discussion. One group believes them to be entirely congenital and to be the result of anomalies developed during the process of fusion of the peritoneum after the rotation of the gut. Konjetzny, in a series of dissections on new-born infant cadavers, has found them present in from fifteen to twenty per cent. of children. Harvey, of New Haven, has also dissected a large series of infants and has also found these membranes present in from fifteen to twenty per cent. of the cases. His work is very inclusive and conclusive in favor of these membranes being purely developmental rather than the result of inflammatory activity in the digestive tube. Nevertheless, there are many surgeons who maintain that these membranes are entirely the result of chronic inflammatory conditions, and attempt to explain their presence in new-born children on the basis of a prenatal inflammatory process. While such inflammation has been recorded as present in several foetuses, it is difficult to believe that such prenatal inflammation would occur in from fifteen to twenty per cent. of the children born. It would also be curious if this inflammatory process, both prenatal and postnatal, should elect to involve the various circumscribed areas in which they are found, to the exclusion of the major part of the peritoneum. It is also suggestive that these areas are located just where the peritoneal fusions are most complicated, with the obvious corollary that anomalies are, therefore, most likely to occur. Moreover, in the majority of instances in adults where these membranes have been dealt with, except for the anomalous distribution, they have had all the characteristics of normal peritoneum, the two layers of which have been held together by delicate areolar tissue.

These statements can be made with the least hesitation about the hepato-duodenal group. Even in this group additional connective tissue, both within and outside of the membrane, but closely associated with it, occurs with sufficient frequency to require explanation. In the group at the duodeno-jejunal angle additional thickening is present in a higher percentage of cases, and in the pericolic group in a percentage somewhat higher than in either of the other two groups. These facts have led me to the conviction that these membranes are primarily the result of anomalies in the fusion of the peritoneum, and that the thickenings occasionally found result from chronic traction, or chronic irritation from toxins or low-grade infections arising within the gut. This deduction would seem to harmonize the anatomical findings in the new-born, and the varied findings in the older operative cases, more satisfactorily than any other.

Many doubt that there is any relation between these membranes and symptomatology because troublesome symptoms usually appear only after twenty, thirty, forty or even fifty years, and yet the membranes, being congenital, have always been there. This argument is without value. Cervical ribs are congenital and yet they cause no symptoms until the possessor is from eighteen to fifty years old, and some patients never have symptoms, the ribs being discovered incidentally in the examination for other disturbances. Yet in the cases that have cervical ribs with symptoms, the removal

of the ribs leads to the disappearance of the symptoms. Again, very young children with fractures of the lower end of the humerus, which have united with posterior deformity, will grow to adult life and then for the first time show symptoms of ulnar paralysis, unquestionably due to an ulnar neuritis, secondary to the fracture deformity which has been present for years. That these membranes do cause mechanical partial obstruction of the gut by angulation and constriction has been repeatedly demonstrated at the operating table. That partial obstruction of the gut causes marked and widespread interference with the orderly functioning of the digestive canal has been proven by the work of Alvarez, Keith, Cannon and others. These disorders of function are naturally followed by the symptoms which bring patients to the physician. Because the majority of these patients, who seek relief, have reached adult life, it was thought that these anomalous membranes did not cause symptoms during childhood and adolescence. However, in nearly every case, careful investigation will show that "weak stomach," "bilious attacks," etc., were common to the earlier years of life.

Moreover, C. G. Kerley, in a symposium on enteroptosis at the New York Academy of Medicine in the Spring of 1921, summarized a series of one hundred cases of infants and young children suffering from marked digestive disturbances and malnutrition. The Röntgen series in the various cases showed pictures just like those in adults where operation has verified the diagnosis of anomalous membrane. While the diagnosis in none of these children had been verified by operation, the clinical and Röntgen pictures together made it almost certain that these cases were showing early evidence of the evil effects of these anomalous membranes. Moreover, in Case XIX of this series, the symptoms were very marked in an eleven-year-old child and were entirely relieved by operation. Several cases in the series later than this first fifty have been in young children (one eight years old), so that it is evident that these membranes may cause symptoms at any period from infancy onward, and that it only remains to get familiar with the characteristic evidences.

Because of the great variability in the age at which definite symptom complexes appear, as well as in the acuteness with which they appear, it has seemed necessary to work out some explanation, based on the fundamental factors concerned, which would account reasonably for these variations in the group as a whole. As time has passed such an explanation has been evolved and is tentatively presented.

The fundamental factors are (1) The anomalous membranes which are congenital and, therefore, always potentially a menace.

The variables in this factor are: (a) The distribution of the membranes; whether present in one or more of the situations previously mentioned. (b) Their size in area and length. (c) Their thickness and rigidity. (d) Their anatomical relations to the digestive tube, which influence the degree of compression, kinking and distortion caused.

(2) The vital energy, both muscular and nervous, of the individual's digestive tube.

Variables: (a) The actual muscular development of the digestive tube. (b) The balance and quality of its innervation. (c) The endocrine balance; a factor the influence of which is not definitely known, but considered of great importance by endocrinologists. (See Timme.) (d) The general vitality and nervous balance of the individual which influence the previous variables. (e) The individual habit with regard to food; both as to frequency, quantity and quality.

As long as factor number 2 is able to overcome the partial obstructions caused by factor 1, with comparatively little effort, there will be no prominent symptoms.

If factor 1 causes more definite obstruction and factor 2 continues energetic, obvious symptoms occur of which pain is apt to be a prominent one. As soon as factor 2 suffers decompensation, then dilatation, stasis and "toxæmia" dominate the symptomatic picture. These phases merge into one another. Factor 2 may be seriously decompensated by any debilitating illness whether acute or long continued, and when decompensation has once occurred the handicap is so great that it cannot be overcome and the symptoms become steadily worse. Where decompensation has not been too serious, the original balance may be partially or completely restored, and so clinical variations occur. This has been the experience in a considerable percentage of the series of fifty presented. The fact that many of them have bilious attacks, cyclic vomiting or acidosis as children, then after puberty have less trouble or even recover for a number of years, lends weight to the argument of the endocrinologist. Consideration of these factors and their variables will at once indicate the innumerable combinations which may exist and modify the clinical history and symptomatic picture at any given time. For this reason it is almost impossible to allocate symptoms definitely to one or other of the anomalous membranes. It has, therefore, seemed best to go over the symptomatology of the series of fifty, as a whole, and then to attempt to group the symptoms accentuated by the different membranes.

Of the fifty, thirty-seven (seventy-four per cent.) were females and thirteen (twenty-six per cent.) were males. The ages ranged from eleven years to sixty-five, but there were very few less than twenty years old. Symptoms of indigestion had been present for periods varying from one and five-tenths to thirty-five years before operation. In some cases the trouble was continuous, in others intermittent, but in all cases it became gradually more troublesome and disabling during the few months, or years, preceding operation. It was noticed repeatedly in the various histories that the symptoms became markedly aggravated after a debilitating illness. In many cases there is a history of digestive disturbances from infancy.

In thirteen (twenty-six per cent.) cases the appendix had been removed; twice for acute suppurative appendicitis, but in the other eleven (twenty-two per cent.) apparently with the *hope* that the digestive disturbances would

disappear, instead of which they were greatly aggravated. This was in the period when obscure digestive troubles were attributed to the effects of chronic appendicitis. One of the series had an exploratory laparotomy and another one two exploratory laparotomies without result in either case. Briefly the symptoms were: Nausea, intermittent but often frequent, in thirty-three (sixty-six per cent.) of the group. Vomiting in twenty-five (fifty per cent.). Many of them had typical recurring bilious attacks. Pain in forty-seven (ninety-four per cent.), which varied in character from acute, colicky pain (usually epigastric) to dull discomfort with a sense of distention, punctuated with gas pains (most definite in the right side). A sensation of dragging or pulling, frequently located by the patient accurately at the site where one of these anomalous membranes was pulling (proven at operation). Before operation this sensation could be relieved by posture, crouching forward or lying with pelvis elevated. Flatulence in forty-six (ninety-two per cent.). Usually very troublesome. Constipation in thirty-three (sixty-six per cent.), often of extreme degree. Diarrhœa in ten (twenty per cent.). Intermittent in most of them. (Complicating colitis.) Toxæmia, so-called, in forty-two (eighty-four per cent.). Headache, troublesome, in thirty (sixty per cent.). Loss of weight in twenty-three (forty-six per cent.), varying from six to twenty-five pounds. Disability to follow occupation in forty-nine (ninety-eight per cent.), which varied from the complete disability of a bed-ridden invalid to the partial disability of continuous discomfort with recurring exacerbations of symptoms which caused temporary complete disability. In thirty-seven (seventy-four per cent.) the disability was estimated at fifty per cent. or more, and in twenty-five (fifty per cent.) almost total disability existed. Mental inertia, lack of concentration, lack of initiative, lack of nervous stamina, varying in degree in different individuals. Constant depression. A sense of exhaustion and somnolence in the afternoon, which was prominent in many of the cases. Mental aberration of mild degree in two (four per cent.). Oral infection was present in ten (twenty per cent.). Epileptic attacks in three (six per cent.) and "fainting spells" in one (petit mal?). Typical biliary colic in two (four per cent.) followed by jaundice in one (two per cent.). There were no stones in either gall-bladder. In each case the cystic duct was distorted and kinked by a part of the membrane.

No temperature except where some complication was present.

In the hepato-duodenal group, the predominant symptoms are pain, nausea and vomiting, gradual loss of weight and stamina. The pain is in the epigastrium and when the gastric musculature is in good condition the pain is colicky and severe owing to the strong peristalsis necessary to push by the obstruction. Some stomachs hypertrophy in overcoming the obstruction and then the pain is very severe. This pain usually starts from half an hour to an hour and a half after eating, is often accompanied by sour eructations, and, often, vomiting alone gives relief. After a time the majority of stomachs fail to compensate for the obstruction, lose tone, dilate, descend toward the pelvis and crowd over to the right flank. It is my conviction that

by this mechanism and sequence of events a large proportion of "fish-hook or ptosed stomachs" are caused, especially since operative relief from the obstruction is followed by rapid improvement in the position and size of the stomach. When the stomach is dilated and ptosed there is dull, steady discomfort, sense of fullness, dragging, fermentation, anorexia, pyrosis and debility. Many of this group have complained of a sensation as if something were pulling downward in the epigastrium, causing a sickening pain. This can be relieved by postural treatment.

The clinical history and findings in all this group are so like those of ulcer that they are difficult to differentiate; however, they fail to furnish evidence that would clinch the diagnosis of ulcer. Many such cases have been explored because of supposed ulcer or biliary calculi. No ulcer and no calculi have been found and the wound has been closed without paying any attention to the membranes. The symptoms have continued.

In the duodeno-jejunal angle group the symptoms are at first quite similar since the obstruction is only slightly further along. However, the pain is just above the umbilicus, vomiting is more frequent, and the vomitus contains bile more frequently and in considerable quantity, as the pylorus is usually dilated from the back pressure. The dilated duodenum can be made out by the method of Hayes. Perhaps the outstanding feature of this group is the great depression, both physical and mental, which is present. They are the most forlorn members of the whole larger group, and yet they respond to proper operation even more quickly than the others.

In the pericolic group, pain and distention in the right side of the abdomen, constipation and the general symptoms usually grouped under the term auto-intoxication, dominate the clinical picture.

Physical examination in the early stages may frequently give but little conclusive information. Many of these patients for a long time are well nourished, even fat; their color is good most of the time and they appear to be in good health. Their chief complaints are of pain, flatulence, constipation, and easy fatiguability, which at first occur in cycles, with varying intervals of relief. As their disturbances become more frequent and persistent, and they limit the dietary more rigidly in the hope of relieving their discomfort, they lose weight; they become sallow and pasty; their general health depreciates; and they become chronic invalids, who are frequently classed as hypochondriacs and avoided by the profession.

In only ten per cent. of the group presented was there definite focal infection in the mouth or tonsils, and the elimination of these caused no marked and lasting improvement. Examination of the heart, lungs and nervous system gives evidence either of normal conditions or of complications irrelevant from the standpoint of etiology.

Repeated examinations of the abdomen, over a considerable period of time, may show nothing abnormal beyond flatulence, and possibly moderate gastric dilation and ptosis. Examination of the gastric contents shows variation in secretions, retention (absent or present), according to the

progress of the trouble, no blood, nor any other evidence which might not be accounted for by a so-called functional disturbance.

Examination of the stools shows nothing of significance beyond variations in bacterial flora; mucus, when colitis (a frequent complication) is present; no blood, or other diagnostic evidence. Moreover, the various food elements usually come through pretty well digested.

After the pathology has progressed sufficiently, certain local signs are likely to appear.

With hepato-duodenal membranes there appears a tender area localized in the mid-epigastrium, sometimes extending over to the gall-bladder. The majority show considerable dilation and ptosis of the stomach with associated physical signs.

With obstruction at the duodeno-jejunal angle, there is usually localized tenderness about 2 or 3 cm. above and to the left of the umbilicus. The duodenum is dilated and this dilation can often be made out by the method described by Hayes. There is secondary dilation of the pylorus and stomach.

With obstruction of the first portion of the colon there appears distention and tenderness in the right lower quadrant (often extending up to the border of the ribs) and, eventually, well localized tenderness over the appendix. At this stage many an appendix has been removed on the basis of a latent chronic appendicitis, causing "reflex digestive disturbances," whatever they may be.

In the great majority of these cases there has never been a frank acute appendicitis, but the appendix, so to speak, has slipped into the clinical picture very insidiously. At some one of many examinations its characteristic localized tenderness is present. Appendectomy in this group fails to give definite symptomatic relief.

"Anomalous membranes" are present in from fifteen to twenty per cent. of people.

Appendectomy for so-called chronic appendicitis, according to Gibson and others, fails to cause symptomatic cure in about twenty per cent. of cases.

These three facts taken together lead to obvious and interesting conclusions.

While the clinical history and the findings on physical examination give results which seem too indefinite to warrant a precise diagnosis, nevertheless, experience with this group will soon enable one to make a fairly accurate estimate of the conditions within a given abdomen.

The one most necessary item for correct diagnosis is a good barium series of the gastro-intestinal tract, correctly interpreted. It has been a not infrequent experience that the X-ray report has been "negative" in cases where operation has shown these anomalous membranes to be present and causing their characteristic disturbances. A review of the barium series in these cases, preceding operation, also shows features which are characteristic. Many reports merely state that "there is no evidence of ulcer" and go into no

further detail. Therefore, one must always look over the series personally in order to do justice to his patient.

Characteristic features shown in the plates of a well-developed hepato-duodenal band are as follows:

Usually the apex of the duodenum (the junction of the first and second parts) is held rather high. Sometimes as high as the lower border of dorsal xii, in the prone position, and the lower border of lumbar i, in the erect position. More often in the same relative positions to lumbar i and ii. In the majority of cases there is distinct dilation and ptosis of the stomach; the greater curvature frequently lying below the pelvic brim.

Another characteristic feature is for the pyloric end of the stomach to be well over to the right of the mid-line, and then for the pyloric antrum, pylorus and first part of duodenum to be turned upward and inward to the vertebral column. This makes the typical "fish-hook" type of stomach. It is also characteristic that the "cap" is rarely well filled out. It is frequently elongated from the downward drag of the ptosed stomach, and may be rather irregular in outline from the influence of the pressure or distortion caused by the attached membrane.

Another characteristic feature is the sharp angulation at the junction between the first and second portions of duodenum. The second portion is frequently compressed by the under surface of the liver and shows as a narrow shadow with a straight upper edge running obliquely downward to the right. Under the fluoroscope the apex of the duodenum is more fixed to manipulation than usual and there is frequently marked tenderness to pressure at this point. As a rule there is no deformity of the cap which is sufficiently definite in repeated pictures to warrant the diagnosis of ulcer.

Peristaltic activity of the stomach varies greatly with the individual case. In those cases with very active peristalsis the stomach is not so likely to be dilated and is apt to have the so-called "cow-horn" shape. It does not reach much beyond the mid-line. These are the unusual cases previously noted and are apt to have excessive pain. The majority, however, have dilatation of varying degree depending on the degree of obstruction, and the greater the dilatation the less vigorous is the peristalsis and the more is the degree of retention. In aggravated cases the retention may be considerable even after twenty-four hours. Where the membrane causes only slight obstruction, the emptying time of the stomach is short, and there is but little dilatation.

In obstructions at the duodeno-jejunal angle evidence is obtained chiefly by fluoroscopy. The barium gets into the duodenum readily, but "puddles" in the dependent portion of the duodenum (second and third portions). There it can be seen to approach the angle and then to be pushed backward toward the pylorus and so to oscillate back and forth with the duodenum, obviously writhing in the attempt to push it along and succeeding after several attempts. Oftentimes in these cases the pictures will show the dependent portion of the duodenum to be considerably dilated, but this evidence is

not always present on the plates. In addition to distention and obstruction in the duodenum, back pressure frequently causes dilation of the pyloric ring with subsequent dilation and ptosis of the stomach.

With the pericolic membrane a characteristic feature is relatively high fixation of the hepatic flexure. Often a comparison of the gastric with the colonic pictures will show the hepatic flexure very closely related, in its position, to the fixed duodenal apex and often the hepatic flexure does not vary its position much between the prone and erect positions; *i.e.*, showing pretty definite fixation.

In addition to the high fixation of the flexure there is often a sharp angulation, the beginning transverse colon running down in contact with the upper ascending colon. There can also be seen, very frequently, definite constriction of the barium shadow at, or near, the flexure. Between this and the cæcum the large intestine is usually dilated and this dilatation increases downward to the cæcum. Where there are several transverse, thickened bands in the pericolic membrane, the outline of the cæcum and the ascending colon will be distorted. In many of the pictures taken after the barium enema incompetency of the ileocæcal valve is evident. There is also, nearly always, a definite stasis in the cæcum and the ascending colon which may persist for twenty-four, forty-eight, or even a greater number of hours. The "club-shaped" cæcum and ascending colon is characteristic. In the majority of these cases, if they have escaped appendectomy, the appendix receives the barium early and retains it throughout the examination. Usually during a fluoroscopic examination there will be found marked tenderness over the appendix, over the hepatic flexure, and often over the intervening colon.

With the history, symptoms and physical findings previously noted, and the group of pictures showing these characteristics, one may be reasonably sure of finding one or more of these anomalous membranes causing disturbance. When the diagnosis is reasonably assured, treatment can be carried out on definite lines.

Primarily, every case in these groups should be in the care of a competent internist over a long period of time. Many of them, by means of a medical régime, logically adapted to the individual case, can be made about as comfortable as the average human being. It has been repeatedly observed that individuals who suffer much under their usual conditions, will be almost entirely free from their symptoms during a holiday in the country or woods where they can lead an out-of-door life, and be free from their usual cares and worries. This, to my mind, represents a rebalancing of the opposing factors previously tabulated (page 19). Return to the ordinary duties of life is followed by a tendency to again upset the balance. In the bad cases the relief during the holiday is less complete and the later relapse is very rapid.

When, in spite of good medical care during months or years, in spite of periods of improvement, there is a general tendency for the symptoms to become more continuous and severe, with corresponding disability, relief by surgical means is indicated. The cases in this series have been treated

on these principles with two resulting advantages; no unnecessary operations have been done; and, inasmuch as the same medical men have followed their cases for long periods, both before and after operation, the interpretation of results is not biased by a one-man surgical opinion. Because of the length of this paper no review of the various methods of surgical attack will be attempted, but merely a statement made of the methods used in this group, with the results that have been obtained.

The Incision.—With one or two exceptions the incision has been a transverse right rectus, placed from 1 to 3 cm. above the level of the umbilicus, according to the patient's conformation. It may be extended outward, splitting the flank muscles, or it may be enlarged inward by splitting the anterior and posterior sheaths of the left rectus and then retracting that muscle to the left. This incision, discussed by Moschowitz years ago, has marked advantages, both immediate and remote, and some slight immediate disadvantages.

Advantages.—1. Immediate: There is perfect exposure, with very little retraction, of the chief focus of trouble; *i.e.*, the right upper quadrant, giving ready access to the liver, gall-bladder, pylorus, duodenum, head of pancreas, hepatic flexure and transverse colon. With great ease the ascending colon and cæcum can be explored, especially the outer gutter, so that pericolic membranes can be readily identified and attended to, and the cæcum and appendix (if still present) can be brought into the wound for convenient removal of the appendix. The duodeno-jejunal angle and dependent duodenum can be seen and manipulated, as necessary, through the inner end of the wound after the omentum and transverse colon have been withdrawn and protected in hot wrappings. By proper retraction and illumination all these structures can be seen as well as felt. The omental adhesions to previous vertical scars can be freed with the minimum traumatism. In addition, the inserted hand can palpate the kidneys, fundus of the stomach, spleen, splenic flexure, descending colon and pelvic organs. With a little care there need be no damage to the muscular innervation so that healing both immediate and remote is favored.

2. Remote: The wound heals with a thin, transverse line scar which shows almost no tendency to spread. It adds merely another "linea transversa" to the rectus which is not damaged thereby. Except in a few unfortunate cases of wound infection there seems to be no tendency to secondary hernia. Such adhesions as occur, during healing, between omentum and the scar are in a transverse line at about the level of transverse colon and, therefore, are so situated as to cause no interference with the digestive tube. Indeed, not many years ago, suturing the omentum transversely to the anterior abdominal wall, in order to make a shelf for the stomach, had quite a vogue in the surgical treatment of gastropexy, and there were many reports of symptomatic cure following this procedure. The adhesions following laparotomies by vertical incision, as seen in certain ones of this series, cause much

more tenderness about the scar, cause more definite symptomatology, and on exploration often show marked distortion and compression of the colon.

The Disadvantages.—1. It takes more time both to make and to close the wound, but not so much more as to constitute a serious disadvantage. 2. There is a tendency for the cut ends of the rectus to ooze after closure, and occasionally there will be a late discharge (twelve to twenty days after operation) of bloody serum from some portion of the wound. This, as a rule, is sterile and delays wound healing only slightly. Occasionally a staphylococcus is present and there is additional delay. Two post-operative hernias only occurred in this series and followed such an infection.

When the peritoneum is divided in the average case, the hepatic flexure appears at the outer angle of the wound and the greater curvature of the stomach (usually pyloric antrum) fills the remainder and major portion, showing that stomach extends far below and much to the right side of where it belongs. Exploration usually shows a sharp bend backward in the pyloric antrum with the pylorus and first portion of duodenum running backward, upward and inward to the duodenal apex, which is firmly moored to the cystic duct by one part of the membrane as previously described.

By retracting the stomach downward and to the left, the hepatic flexure downward, and the liver and gall-bladder upward and to the right, the hepatoduodenal membrane and its accessory variations can be clearly demonstrated. Without this retraction the membrane might escape notice, since the position on the operating table causes the viscera to slide upward and so causes relaxation of the membrane. Also this retraction is essential to indicate the mechanical disturbance caused by the membrane when the patient is in the vertical position. When the membrane is exposed and put on the stretch, it is divided by scissors, parallel to and a little below the gall-bladder. The incision is continued through the anterior layer of the gastro-hepatic omentum a sufficient distance to permit mobilization downward and forward of the duodenum and pylorus. Usually the membrane contains no vessels of significance and section is bloodless. Just above the pylorus where there are often vascular bands, it may be necessary to divide between double ligatures to get sufficient mobilization. The raw surfaces thus exposed are covered in by a continuous catgut Lembert suture of the peritoneal edges, to minimize the post-operative adhesions. The final result in the average case brings the apex of the duodenum forward and downward to lie near the fundus of the gall-bladder (forward 6 to 10 cm. and downward 4 to 8 cm.), so that the axis of stomach, pylorus and duodenum form an easy, natural curve instead of the elongated, angulated line previously present. The distortion, kinking and compression disappear under the eye. When gall-stones or cholecystitis are present, cholecystectomy is done.

In obstructions at or near the duodeno-jejunal angle two procedures have been followed: 1. When the obstruction was obviously due to kinking, distortion and compression from membranes, a plastic operation was done to restore the normal position and mobility of the angle. 2. When the obstruc-

tion was apparently due to compression by the superior mesenteric vessels, duodeno-jejunostomy between upper jejunum and the dilated dependent duodenum (third portion or junction of second and third portions) was done. Some of these were done without dividing the layer of inferior mesocolon overlying the duodenum, but rather using it as though it were the peritoneal covering of the duodenum. In others the overlying mesocolon was divided and the duodenum somewhat mobilized for greater convenience, according to the technic described by Kellogg. Whether by chance or otherwise the group in which the mesocolon was divided were much more uncomfortable for the first few days after operation. On the other hand, this method avoids the mischance of injuring a large vein which runs obliquely upward and to the left across the third portion of duodenum, a mischance which fortunately did not occur in the other small group.

In choosing between the plastic mobilization and duodeno-jejunostomy, the results, as will be seen in a later paper in this small group of cases, indicate that the anastomosis is invariably the better procedure. Kellogg stresses this point. The anastomosis should be of generous size (4 to 5 cm.), and where the mesocolon is split, its edges should be tacked to the duodenum just as to the stomach in gastro-enterostomy.

In dealing with the pericolic membranes the guiding principle has been to cause just as little traumatism as is necessary to release the colon from kinking, compression and distortion. Therefore, thickened bands or cords have been divided (between double ligatures where vascularity demanded it) and the remaining membrane has been divided parallel to the outer side of the gut. The gut expands at once so as to separate the divided ends and edges from 5 to 7 cm. Inasmuch as the true peritoneal coat of the gut is usually not adherent to the membrane along the outer wall of the colon, there should be no great tendency for post-operative adhesions to form between the gut and parietal peritoneum where the membrane has been divided and its edges separated. Where bands and cords have been divided between ligatures the raw stumps have been inverted by catgut sutures. Complete removal of pericolic membrane is advocated by a number of surgeons. Since these membranes are very frequently adherent to, or fused with, the true peritoneal coat along the anterior summit of the gut, this procedure has seemed to me both to waste time in the actual dissection, and to really prejudice the final outcome by necessarily causing true unperitonealized areas along the summit of the gut which would almost surely adhere to parietal peritoneum during healing.

Where the origin of the omentum has extended around the hepatic flexure and down the ascending colon, causing sharp angulation at the flexure, the omentum has been split and the two limbs of gut freed from each other. The raw edge on the left side has been turned in so as to leave the omentum free and minimize adhesions, and the right side turned backward and tacked to the inner side of ascending colon, so as to minimize recurrent deformity. When omentum has been adherent to the scars of previous

operations, it has been carefully separated right at the parietal peritoneum. The raw stump of omentum has been turned in upon itself by catgut suture so as to try to prevent it from again adhering. Where the parietal peritoneum at the scar is denuded over only a narrow line it is often possible to fold it in by a running catgut suture and so diminish the likelihood or extent of post-operative adhesions. The appendix is always removed when present. After the abdomen has been completely explored, and such of these conditions as exist in the individual case have been cared for, the wound is closed by layer sutures, without any drainage.

From the very start frequent changes are made in the position of the patient, who within a few days can voluntarily roll about unaided and without discomfort. The first post-operative dressing is done on the tenth day and the skin and tension sutures removed. They sit up on the seventeenth day and leave the hospital a few days later. After the twelfth to the fourteenth day light abdominal massage is started and is gradually increased in vigor, special attention being given to the right upper and lower quadrants. This massage is continued for from four to six weeks, by which time the region of the scar is usually flexible and free from tenderness, and the abdomen as a whole seems normal to physical examination. The importance of this early massage has seemed increasingly evident as time goes on.

Results.—The immediate post-operative period was usually uneventful except for the customary discomforts. There was one subphrenic abscess without known cause. Recovery followed its evacuation. Three cases developed deep wound infection on the ninth, tenth and twelfth days. Two of them developed subsequent hernias. One was successfully repaired under local anæsthesia. One refused to have a repair. The third case did not develop hernia. One case had a slight discharge of serum from the outer angle of the wound about the tenth day. There was no delay in the final healing. This is a heavy incidence of defective wound healing. Many plausible reasons could be advanced but perhaps the plain statement of fact is best. There was one death in the series from pneumonia on the fifth day. In the remaining cases wound healing was by solid primary healing. After the first few weeks practically all of these wounds are free from tenderness to pressure. After the first few days of post-operative discomfort have passed the patients volunteer interesting facts.

Those who have had a sense of dragging from hepato-duodenal membrane state that it has disappeared; the old tendency to fulness, gas eructations and nausea have gone; real appetite, which has been absent for weeks, months or years has returned; foods can be taken with comfort which had always disagreed previously. The bowels begin to act with far less help than has been necessary for a long period, and in very many cases after the return to regular duties, no cathartics at all are necessary. Their faces lose the drawn, haggard, worried expression so common to the group, and the sallow, pasty complexion begins to clear up. Many of them state that the sense of mental depression and lack of power to concentrate which has

prevented efficiency has disappeared within a very short period. They gain in weight (five to thirty pounds within the first six months) and their strength and endurance are greatly increased.

In general terms, the longer the duration of the disabling symptoms preceding operation the slower is the rate of recovery. This is especially true where so-called auto-toxæmia has been present. Also, the older the patient, the less prompt and complete is the recovery likely to be, although there are many exceptions. Where colitis and perihepatitis, one or both, are present as complications, the recovery is slower, more irregular and less complete.

Along with the improved general condition there are corresponding signs of improvement on examination of the abdomen. The stomach rapidly diminishes in size to more nearly its normal location, losing a large part of its ptosis and enlargement to the right of the median line. The pain, distention and tenderness localized in the right side of the abdomen, especially the lower quadrant (in the cases of pericolic membrane), disappear within a few weeks.

In five of this present series obstruction was present at, or near, the duodeno-jejunal angle. In four of them relief was attempted by plastic work instead of by duodeno-jejunostomy. While they have shown definite improvement, the result has not been nearly so satisfactory as in a group, later to be published, where the anastomosis was done. In the fifth case the anastomosis was done and much improvement occurred, but other non-digestive troubles have prevented a real recovery of health and strength.

In only one of the group of fifty was a post-operative series of pictures obtained (about eleven months). These showed the stomach smaller and more vigorous, the pylorus definitely lower, and the axis of the cap slanted almost horizontally to the right as contrasted to an almost vertical axis before operation. Also the colon showed no stasis, and the dilatation of cæcum had disappeared. She no longer suffered from constipation. Some three years later the abdomen was opened again. The pylorus and beginning duodenum were suspended from the anterior edge of the right lobe of the liver by a thin fold of adhesions about 4 cm. long, which in no way distorted or compressed their lumen. They were visibly anterior to their position before the first operation by 10 cm. and at a lower level by 5 cm. This one case proves the possibility of permanently changing the position of the stomach outlet and also the direction of its axis with freedom from recurrence of kinks or compression.

Tabulating the results with regard to symptomatic cure furnishes interesting data. The terms "cured," "much improved," "improved," "unimproved," "died," have been used. "Cured" is applied only to those cases who are perfectly free from all digestive discomforts, restrictions in diet, constipation, etc., and in whom there has been full return of nervous and physical energy and capacity to do their work. "Much improved" has been applied to those who have returned almost to normal, but who still

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have slight disturbances of digestion of one sort or another, or some remaining impairment of vigor. At least nine of the twenty-six so tabulated might fairly have been classed as cured, since they are as well as the average person, but they have slight disturbances and so were placed in this second best group. "Improved" includes those who were definitely benefited but were not able to resume their full duties in life.

This table is made up on the basis of written reports from the patients in answer to questionnaires. The time of the latest report after operation is specified in the abstract of each individual history. These times have varied from three months to seven and one-quarter years. Of the sixteen cured, fourteen were followed from two and one-half to seven and one-quarter years. Of the twenty-six much improved, eighteen were followed from two and one-half to four and one-third years, sufficient time in each group to get a fair estimate of end results.

It will be seen that the only "cures" occurred in the upper two groups, and that the percentages are fairly high. If the "much improved," who were

			Cured	Much Improved	Improved	Unimproved	Died
			%	%	%	%	%
1.	30 Hep.-Duod. and Pericolic...	11	(36⅔)	*16 (53⅓)	1 (3⅓)	1 (3⅓)	1
2.	13 Hep.-Duod. and H. D.-colic.	5	(38.4)	*6 (46)	0	2 (15.4)	
3.	3 Hep.-Duod., Duod.-Jej. and Pericolic.....	0		2 (66⅔)	1 (33⅓)		
4.	1 Duod.-Jej. and Pericolic.....	0			1		
5.	1 Duod.-Jej. and Hep. Duod..	0		*1			
6.	2 Pericolic.....	0		1	1		
	50	16	(32%)	26 (52%)	4 (8%)	3 (6%)	1 (2%)

1. *0 practically cured.
2. *1 practically cured.
3. *1 practically cured.

practically all returned to full duty, are admitted as qualified "cures," the percentage of highly satisfactory results in the first two groups would reach ninety per cent. and eighty-four and four-tenths per cent., respectively. In similar manner the cures in the whole group were thirty-two per cent.; or adding the much improved, who were all back at duty and nearly well, one would get eighty-four per cent. highly satisfactory results. In the remaining four small groups in which no "cure" was obtained, it will be noticed that disturbance about the duodeno-jejunal angle was present in three groups, and in all but one (Case No. XLIX) of these cases plastic work was used to relieve the obstruction rather than duodeno-jejunostomy.

Inasmuch as both hepato-duodenal and pericolic membranes were present in both of the upper groups in which cures were obtained in high percentage, it would seem that the duodeno-jejunal angle complication and its method of treatment were responsible for the relatively poor results in groups 3, 4 and 5. This deduction is borne out by the much better results obtained in a small group to be published in a later series in which duodeno-jejunostomy was the method used. This confirms the deductions reached by Kellogg, previously published in the series reported by him. In most of these cases

which were only moderately improved, or were unimproved, there were complicating factors other than the membranes themselves which helped to prevent the attainment of satisfactory results. (See case histories.)

SUMMARY

1. Anomalous membranes are present in from fifteen to twenty per cent. of new-born infants.

2. They result from atypical peritoneal fusion during fetal life. Many of them are probably modified by later pathological changes due to continued traction, irritation, or low-grade inflammation.

3. They occur in the hepato-duodenal region, at the duodeno-jejunal angle, and about the cæcum, ascending colon, hepatic flexure and beginning transverse colon.

4. Two or more of these regions are involved in the majority of individual cases. Groups of cases illustrating the results of treatment of the membranes found in the individual locations have been published by various men. Hepato-duodenal group by Harris; duodeno-jejunal groups by Kellogg; and pericolic group (Jackson's membrane) by Jackson, but sufficient emphasis seems not to have been put upon the fact that two or more of these lesions exist in the majority of individuals who fall within the whole large group.

5. They cause mechanical disturbances, fixation, angulation, compression and torsion of the digestive tract resulting in partial, continuous and often increasing obstruction. This, in turn, frequently causes dilation proximal to the obstruction.

6. Symptoms result when the obstruction becomes greater than the peristaltic efficiency can easily overcome. This balance may be gradually lost over a long period of time, with resulting slowly increasing symptomatology. It may be suddenly lost as the result of a prostrating injury or illness, the obstruction remaining constant while the viscus, becoming atonic, is no longer competent to overcome it. Sometimes the viscus regains its relative power and the symptoms improve. Often the viscus can never overcome the handicap and symptoms are continuous and progressive.

7. For a long time it was thought that these cases developed symptomatology only after twenty years or more of age. The investigations of Kerley in infants and children suffering from malnutrition, cyclic vomiting, recurrent acidosis, etc., show that abdominal examination and studies of the barium gastro-intestinal series give precisely the same findings as do the older cases in which operation has demonstrated the lesions, and caused cure in a high percentage of cases. This would indicate that symptoms appear in definite form at any period of life when the balance of peristaltic efficiency against the partial obstruction is lost.

8. The symptomatology consists of: Digestive disturbances previously described; general nutritional disturbances; nervous debility, usually termed neurasthenia (and occasionally mild psychosis). At some period the appen

dix is likely to become tender to pressure, is assumed to cause the symptomatology by "reflex action," whatever that may be, and is removed, with failure to cause improvement.

9. There are usually tender spots in the mid-epigastrium, over the appendix, over cæcum and ascending colon, and over the duodeno-jejunal angle, depending upon the presence of the various lesions. There is varying dilation and ptosis of the stomach, and varying dilation of cæcum and ascending colon. In marked obstruction at the duodeno-jejunal angle the dilated duodenum can be made out.

10. Examination of gastric contents and stools gives no evidence of value as a rule.

11. The most important element of evidence is found in the barium gastrointestinal series. It must be a good series, with sufficiently frequent plates. The plates must be read by one experienced in these cases. It is common to receive typewritten reports that the plates are "negative" or that the digestive tract is "normal" when inspection of the plates shows characteristic evidence to be on the plates. Fluoroscopy should be done by one experienced in these cases, especially to determine the presence of obstruction at the duodeno-jejunal angle, indicated by marked distention of dependent duodenum, with writhing and rushing of the contents back and forth. The pictures are not quite so conclusive, and on the operating table the duodenum may be empty and the condition not so obvious.

The plates are likely to show:

Hepato-duodenal Membrane: The stomach dilated, ptosed, with varying peristaltic activity. With or without retention. The apex of duodenum fixed high, sharply angulated and showing little mobility. The cap is often deformed but not in the way characteristic of ulcer. The second part of duodenum is likely to be compressed and narrowed.

Duodeno-jejunal Angle Obstruction: Dependent duodenum, if dilated, may or may not show definitely on the plates.

Pericolic Membrane: The hepatic flexure shows high fixation (often near the duodenal apex), angulation, and often transverse colon descends in contact with ascending colon. Cæcum and ascending colon are dilated. Ascending colon often showing constriction at about its middle. Appendix, if still present, usually retains the barium for long periods. Ileocæcal valve is often incompetent.

12. Treatment: (a) Prolonged medical. (b) Surgical. Best incision is "transverse right rectus," as it gives best exposure of the whole field, and post-operative adhesions are in least troublesome situation. (c) Post-operative. Abdominal massage. Medical supervision of diet and general hygiene, etc.

Results very satisfactory, as a whole. (See table, page 531.)

NOTE.—Grateful acknowledgment is made: to Doctors Meara, Goodridge, Niles, Williams, and Painter for their interested collaboration in working out the

problems presented in the paper and for following up, before and after operation, these patients from the medical standpoint.

To Dr. John B. Walker for the privilege of assisting at operation on the first case of this type in the author's experience, and for the privilege of including this case in the group herewith published.

To Dr. H. M. Imboden for his collaboration in working out the X-ray picture interpretations in this type of cases. To Dr. L. T. Le Wald for assistance in the X-ray problems.

In giving the case abstracts all non-essentials have been avoided in order to save time and space. Ether anæsthesia was used in each case. The term T. R. R. equals "transverse right rectus." Surgical procedure is termed: "Mobilization, duodenum, mobilization, colon," etc.

In every case these terms indicate the treatment of the corresponding membranes according to description of the technic in the body of the paper. Also in nearly every one of the cases there has been prolonged medical treatment preceding consideration of operation. In some few cases where the condition was obviously unpromising from the medical standpoint, this preliminary treatment was not undertaken.

One of the things that experience has taught the group interested, is that an *early* barium series is very likely to clear up the diagnosis and make treatment far more definite and logical. It is interesting to note in these cases that the longer the period which has elapsed between operation and report, the greater improvement seems to have occurred in the majority of cases. In the few unfortunates who have been classed as "unimproved" time has seemed to make no difference. The latest reports coming in have necessitated revising the group of results because of the reports being much better than those received one and two years before. This is a very satisfactory feature because the one fear has been that after a long period of time post-operative adhesions might cause a recurrence of the old disturbances. This seems not to be the case.

The case histories have not been given in the order of their numbers but have been grouped according to the combinations of membranes found, so that the similar cases will be all together for the convenience of the reader in working out symptomatology, procedure and results. Cases XLVI, XLVIII and L have been included in the group of hepato-duodenal-pericolic membrane group, because the angulation at duodenal cap was only a variation of that in the true hepato-duodenal membrane type.

Group No. 1.—Hepato-duodenal membrane: Case Nos. I, II, III, X, XI, XII, XIV, XIX, XXVIII, XXIX, XXX, XLIV, XLVII.

Group No. 2.—Hepato-duodenal membrane and pericolic membrane: Case Nos. IV, V, VI, VII, VIII, IX, XIII, XV, XVI, XVII, XVIII, XX, XXII, XXIII, XXIV, XXV, XXVII, XXXII, XXXIII, XXXIV, XXXV, XXXVII, XXXIX, XL, XLI, XLIII, XLV, XLVI, XLVIII, L.

Group No. 3.—Hepato-duodenal membrane and duodeno-jejunal membrane: Case No. XXI.

Group No. 4.—Duodeno-jejunal membrane, pericolic membrane: Case No. XXXI.

Group No. 5.—Pericolic membrane: Case No. XXXVI.

Group No. 6.—Hepato-duodenal membrane, duodeno-jejunal membrane, pericolic membrane: Case Nos. XXXVIII, XLII, XLIX.

CASE I, C. R., F. Twenty-seven years. Previous operations: appendectomy and exploration of gall-bladder. Duration of symptoms, always. Nausea and vomiting since childhood. No pain until 1908 when she had a sudden attack in the lower right side with nausea, vomiting and fever. Recurrences until March, 1909, when a chronic catarrhal appendix was removed. Since this operation there had been pain between the umbilicus and gall-bladder which was increased by exercising, by bending backward and by fatigue. Nausea and vomiting became worse. Gall-bladder exploration March, 1914. No stones or inflammation. Wound closed. Symptoms grew worse steadily. From August 1, 1914, to September 23, 1914, she was confined to bed most of the time.

P. Ex.: She is a large, well nourished, rather nervous woman. Weight 147 pounds. Scars of two operations, upper scar quite tender. General examination otherwise negative.

X-ray series: Showed "many apparent adhesions between the stomach, pylorus and gall-bladder." Pre-operative diagnosis: Hepato-duodenal membrane.

Operation: 9-23-14. Incision: vertical. Findings: Stomach: somewhat enlarged. Duodenum: apex, held high and kinked by definite hepato-duodenal membrane. Procedure: Membrane divided; edges sutured. Convalescence: uneventful.

Result: Pain, nausea and vomiting were relieved at once, and have never since recurred. Cured, seven years.

(For the privilege of including this case, which was the first one I had ever seen, and for the privilege of assisting at the last operation, I wish to express my acknowledgment to Dr. John B. Walker. It was perhaps the most dramatic case in the whole series.)

CASE II, L. S., F. Forty-eight years. Duration of symptoms: seventeen years. Nausea and vomiting; frequent. Pain, constant. Flatulence and constipation with considerable loss of weight. Much headache, exhaustion, almost complete disability.

P. Ex.: Pale, sallow woman weighing 140 pounds. Very neurasthenic. Examination of chest, urine, stools, gastric contents: negative. Abdomen: distended. Tender spots were present over appendix, over left iliac fossa and sigmoid which was spastic, and just above and to the right of the umbilicus, and just beneath the free border of the right ribs.

X-ray series: Duodenum: fixed high. Stomach: fish-hook type, six hours retention, cap slightly deformed. Stasis in ascending colon. Appendix: visualized throughout. Marked gastropnoxis in the erect posture. No gall-stones were seen. Pre-operative diagnosis: Hepato-duodenal membrane. Chronic appendicitis.

Operation: 5-15-15. Incision: T. R. R. Findings: Stomach: enlarged but showed no sign of ulcer. Duodenum: fixed to gall-bladder and liver and was markedly compressed by a hepato-duodenal membrane extending half way to the fundus of the gall-bladder and passing down across the duodenum to beginning transverse colon. Liver: showed marked perihepatitis. A small segment removed for the microscope showed normal liver cells but much thickened capsule. Appendix: atrophic. Procedure: membrane divided. Appendectomy. Convalescence: uneventful.

Result: 4 months after operation she had gained 14 pounds, felt stronger and better in every way than for years. Moved away from city and is untraceable. Much improved—four months, then lost.

CASE III, G. A., F. Thirty-one years. Previous operation: ovariectomy eight years previous. Abdominal pain for years. Subject to regurgitation of sour stomach contents, much flatulence. Of late has had much pain in right iliac fossa. Has always been strong and able to work.

P. Ex.: Large, well nourished woman showing tender spots in mid-epigastrium, just below and to the right of umbilicus, and over the appendix. Examination of gastric contents and stool: negative.

X-ray series: Shows high fixation of duodenum with angulation. Cap shows constant deformity. Stomach: markedly dilated and ptosed. Empty at six hours. Barium in appendix for ninety-six hours. Pre-operative diagnosis: Hepato-duodenal membrane. Chronic appendicitis.

Operation: 3-14-16. Incision: vertical right rectus. Findings: Stomach: very much enlarged and ptosed. Distended enormously with gas two times during operation so that a tube had to be inserted and left. Duodenum: fixed high beneath the liver by a thick membrane running from the middle of gall-bladder and cystic duct to duodenum, pylorus and colon, allowing no mobility to apex of duodenum. Appendix: distended, thickened and rigid. Procedure: Gastro-enterostomy; because of thickness and vascularity of membrane, making mobilization too difficult. Appendix resected, stump inverted. Pathological report: Appendix shows involutionary changes only. Convalescence: Uneventful.

Result: Digestion normal, has to avoid greasy foods. Slight constipation. General health and comfort much better. Much improved, one year, nine months.

CASE X, C. G. H., F. Forty-seven years. Symptoms: bilious attacks since childhood. At thirty-one years of age had an abdominal injury. One year later had pain in iliac fossa with fever and nausea. Thereafter, frequent abdominal pain. Constipation became more marked, worse for the last two years. During these two years much nausea, headache and lassitude, such that she was almost completely disabled.

P. Ex.: Small, fairly well nourished, sallow, neurasthenic. Examination of gastric contents, stool, urine: negative. Abdomen: somewhat distended; showed tenderness just below xiphoid and over cæcum.

X-ray series: Showed high fixation of duodenum with limited mobility. Stomach: enlarged and ptosed. Cæcum and ascending colon: showed retention with dilation. Shadows in gall-bladder region were interpreted as stones. Pre-operative Diagnosis: Hepato-duodenal membrane. Biliary calculi. Pericolonic membrane.

Operation: 3-24-17. Incision: T. R. R. Findings: Gall-bladder: normal. Liver: showed hepatitis and perihepatitis. Small wedge removed. From the cystic duct and proximal gall-bladder was a membrane running across the duodenum, pylorus, pyloric antrum to transverse colon, causing distortion and kinking of the stomach and colon. Stomach: enlarged and distended with gas. Pushed well over into the right flank then curved back, inward and upward, showing a kink in the pyloric antrum. Appendix: ran up the outer side of cæcum, firmly adherent throughout. From its tip a firm band of connective tissue ran upward and inward to anterior summit of colon. This caused cæcum and colon to rotate and buckle. Omentum: came around the hepatic flexure and down the ascending colon, attached to the front of the colon. This caused rotation inward of the colon so that the ileocecal valve lay directly posterior instead of to the inner side of cæcum. Procedure: Hepato-duodenal band was disposed of. Appendix removed and stump inverted. Omentum cleared from cæcum and ascending colon. Pathological report: Involutionary appendix. Liver capsule;

chronic perihepatitis. Liver cells normal. Convalescence: Uneventful. Improvement rapid.

Result: Digestion greatly improved. Very little pain. No nausea. Rarely constipated. Gained five pounds in weight and very much in well-being. Much improved, nine months, then lost.

CASE XI, E. C. H., F. Fifty years. Previous operation: gall-stones and chronic appendix at same time. Symptoms for fifteen years. Epigastric pain, constipation, flatulence, sleeplessness, nervousness and lack of strength. Following her operation there was no improvement. Symptoms became more severe until now she is disabled. She has always been fat.

P. Ex.: Short, very fat woman of good color. Examination of chest, gastric contents, stool, blood, urine and pelvic viscera: negative. Finger joints show chronic arthritis. Abdomen: prominent, very fat wall, shows long right rectus scar. Great tenderness all along scar, especially at upper end. Also marked tenderness midline just below the xiphoid.

X-ray series: Show high fixation and angulation of duodenum both erect and prone positions. Pre-operative Diagnosis: Hepato-duodenal membrane. Adhesions.

Operation: 6-19-17. Incision: T. R. R. Findings: widespread adhesions everywhere; between omentum, anterior parietal peritoneum and edge of liver nearly to median line. When these adhesions were freed the stomach was exposed. The upper anterior surface of pyloric antrum was adherent to the bed of the gall-bladder, which had been removed. Running from the under surface of liver across front of stomach was a band of connective tissue 2 cm. wide, quite vascular, causing kinking and compression almost like an hour-glass. After the stomach was dissected from the gall-bladder bed a perfectly typical hepato-duodenal membrane 1 cm. long, absolutely inelastic, was found holding the duodenum high and causing compression and angulation. Procedure: The bands were divided and the stomach mobilized. Convalescence: Slow and unsatisfactory. On the seventh day there was a slight suppuration at the inner angle of the wound. On the twenty-first day she sat up. On the twenty-second day had pelvic pain. Urine showed culture staphylococcus albus. Home on the thirty-fifth day.

Result: She was unwilling to coöperate and for two years her report was such that she was classified as a complete failure. Failure, four years, six months. (Later report.)

CASE XII, M. S., F. Twenty years. Previous operation: Appendix removed two years ago. For four years had periodic headaches which were becoming steadily worse. Nausea and persistent vomiting with abdominal pain. After removal of the appendix no relief of symptoms but dull, steady pain in the right side followed. There is no constipation, no loss of weight. Pain is worse on standing; is slightly relieved by crouching and by abdominal belt. She loses about thirty per cent. of her time from her work.

P. Ex.: She is of small size, well nourished and of good color. Examination is negative with regard to everything except the abdomen, which shows a two-inch appendix scar at the outer edge of the right rectus. Edges tender all about the scar. There is marked tenderness in the mid-epigastrium to the right of the middle line. There is not much gas.

X-ray series: Show high fixation and immobilization of the duodenum with marked gastropnoia and colopnoia. There is persistent unevenness of the cap and much elongation of first portion of duodenum. Pre-operative Diagnosis: Hepato-duodenal membrane. Adhesions—post-operative.

Operation: 7-24-17. Incision: T. R. R. Findings: Duodenum: held firmly under the cystic duct by a firm hepato-duodenal membrane running half way out to the fundus of gall-bladder. Stomach: dilated moderately. Small omental

adhesion to the upper end of appendix scar. Procedure: Before the division of the hepato-duodenal membrane, the duodenum, which was angulated and compressed, could not be displaced downward. The fold was divided transversely and with little blunt dissection the duodenum was mobilized downward 7 cm., and was freed from kinking and compression. Adhesions and omentum were separated from appendix scar. Convalescence: Uneventful.

Result: Absolutely free of symptoms. Works one hundred per cent. of time. Cured, four years, six months.

CASE XIV, A. H. M., M. Forty-five years. Symptoms twenty-eight years. Pain in epigastrium increased by swimming, rowing, erect posture, or by anything which puts tension on the rectus muscles. The pain was almost constant and increasing in severity. Could not lie on stomach or left side. Some relief by crouching. After a time headaches, gastric pain, constipation, flatulence, nervousness, insomnia, anorexia and loss of weight became increasingly troublesome. Fourteen years after beginning of pain an exploration was made through a median, upper abdominal incision. No ulcer or gall-stones were found and the wound was closed. Symptoms became worse. There was twenty-five to thirty per cent. disability with regard to his professional work and he never worked with any comfort.

P. Ex.: Five feet eight and one-half inches high, weight 104 pounds. His frame was slight, was emaciated, pale, haggard, with the drawn face of chronic suffering. He stands and works in a slightly stooped attitude because of the relief thus afforded. Examination, except for abdomen, negative. Abdomen: shows median scar which is very tender throughout, especially to the right of its upper end. Cannot endure slightest pressure. There is increased localized tenderness just above and to the inner side of R. A. S. S. The abdominal wall is retracted and scarcely moves during respiration.

X-ray series: Show high fixation of pylorus, duodenum and hepatic flexure. There is deformity of the cap and sharp angulation of the duodenum. Slight stasis in the ascending colon. Pre-operative Diagnosis: Hepato-duodenal membrane. Pericolic membrane. Adhesions.

Operation: 8-17-17. Incision: T. R. R. Findings: Adhesions between omentum and the old median incision. Pylorus: adherent to fundus of gall-bladder and duodenum ran backward along the gall-bladder in contact throughout its first portion. There was a firm band running from the pyloric end of lesser curvature of stomach to the edge of liver just to the left of round ligament. Stomach: moderately dilated and ptosed. Cæcum and appendix: were just beneath the right lobe of liver and ileocæcal valve at postero-external relation to inverted cæcum. A peritoneal fold ran from the cæcum upward beneath and to the right of appendix to the liver edge. From the cæcum the large gut went downward and at about the middle of ascending colon turned upward to follow its normal course. Procedure: Adhesions to old scar were separated. Adhesions between stomach and liver were divided. Adhesions between pylorus, duodenum and gall-bladder divided; duodenum mobilized downward 7 cm. Appendix: removed. Cæcum: mobilized downward to its normal situation. Convalescence: Uneventful.

Result: After four and one-half years still has epigastric pain and some headache. Has no gas, no constipation. Appetite much better. Has maintained a gain of ten pounds. General health and capacity for work much increased. Much improved—four years, six months.

CASE XIX, C. S., F. Eleven years. Instrumental delivery following difficult labor. Had cyanotic attack on second day. Up to the age of seven she developed normally except for digestive disturbances. When seven she began to have attacks of petit mal. Her digestive disturbances grew worse; was subject

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to headache, nausea, vomiting and marked constipation. In spite of a good appetite and taking large quantities of food she lost considerable weight. When ten years old had her first attack of grand mal, since which there has been a number of both grand and petit mal attacks. There has been some loss of memory. When ten years old tonsils and adenoids were removed. There was temporary improvement in general health, but attacks recurred shortly afterward.

P. Ex.: Tall, fairly nourished girl, rather pale, with a pasty complexion and showing considerable acne. Examination of throat, chest, gastric contents and stools: showed nothing of moment. Abdominal examination: showed tenderness over the appendix and to the right of the median line in the mid-epigastric region. Also showed free descent of the liver on inspiration and a stomach which seemed enlarged and ptoed to percussion.

X-ray series: Showed well-marked enteroptosis. Stomach: very much dilated; marked six-hour retention; no evidence of ulcer. Duodenum: fixed high and kinked beneath the liver. Flexures of the colon were low; both below the level of iliac crest. Cæcum: was deep in the pelvis. Examination of the urinary tract and chest showed nothing abnormal. Skull: showed signs of prolonged, increased intracranial pressure. Pre-operative Diagnosis. Hepato-duodenal membrane. Chronic appendicitis.

Operation: 1-30-18. Incision: T. R. R. Findings: Duodenum: fastened high up to under surface of liver just to the left of cystic duct by a firm, fibrous band. Hepato-duodenal membrane: extended 6 cm. outward along the gall-bladder, ran across the front of duodenum to beginning transverse colon. Stomach: greatly dilated. Appendix: small and adherent to iliac fossa. Procedure: Adhesions and membrane between gall-bladder, liver and duodenum were divided and the duodenum mobilized downward about 5 cm. Appendix: freed, removed and the stump inverted, as usual. Convalescence: Uneventful. She made a perfect recovery.

Result: Three years, six months after operation all of her digestive disturbances had disappeared. She has grown rapidly in size, her color has cleared up and she has been full of energy and has made a high stand in her class at school.

Cured, three years, six months. (Her attacks of grand mal continued and exploration of the brain showed a large cyst in the right temporal sphenoidal lobe, which was evacuated.)

CASE XXVIII, T. B., F. Twenty-nine years. She was well until twenty-seven and one-half years old, when she developed a steady pain in the right hypochondrium accompanied by nausea and vomiting. There was no temperature. The attack lasted two to three hours. During the succeeding eighteen months there were about twenty-five similar attacks. During that period she also had one attack of pain lower down which ran into the urinary bladder and was accompanied by strangury. Between her frequent attacks of abdominal pain her appetite was good and her bowels rarely constipated. She was somewhat addicted to alcohol and tobacco. The remainder of her history is irrelevant.

P. Ex.: Woman of medium height but large frame and fat. Good color. Examination of chest, gastric contents, stools, etc.: negative. Abdomen: prominent, wall flabby, small omental umbilical hernia. There was no tenderness over the appendix. Some tenderness over sigmoid. Just to the right of the mid-line, opposite the eighth costal cartilage is marked tenderness over an area of 3 cm. in diameter. Percussion shows a dull note in this area. Liver: not enlarged. Kidneys: negative. Stomach: does not seem enlarged.

X-ray series: Shows one shadow somewhat definite that might indicate a gall-stone. Shows stomach somewhat enlarged and ptoed. Peristalsis seemed normal. No indication of ulcer. Emptying time four hours. Duodenum: fixed high beneath liver, and angulated. Cæcum: somewhat dilated. Appendix: held

barium through examination. Ileocæcal valve: incompetent. Pre-operative diagnosis: Hepato-duodenal membrane. Biliary calculi. Chronic appendicitis.

Operation: 5-14-18. Incision: T. R. R. Findings: Stomach: much dilated, well over to the right side; turned backward, upward and inward to duodenum, which was firmly fixed by a broad hepato-duodenal membrane. Gall-bladder: contained numerous small stones. Appendix: showed several small fecal masses. Procedure: Gall-bladder removed; the stump of cystic duct sterilized and covered in by peritoneum. Duodenum: mobilized downward 6 cm. Appendix: removed and stump inverted. Convalescence: Uninterrupted.

Result: Has never had any digestive trouble since operation. Cured, three years.

CASE XXIX, M. M., M. Forty years. Always well until twenty-five years old. Then recurring attacks of pain every few weeks. When thirty-three acute perforative appendicitis occurred. Operation was followed by prompt healing and much improvement in digestion. Slow recovery of strength. Whenever tired or nervous old digestive attacks would recur. His bowels have been fairly regular. His weight varies from 130 to 140 pounds. No nausea or vomiting but little flatulence. Chief disturbances are attacks of pain, nervous depression and disability that goes with them.

P. Ex.: He is a medium-sized, well-nourished man. Sallow color. Examination is negative with regard to gastric contents, stools, etc., and with regard to chest and urine. Abdomen: shows scar of the appendix operation but no tenderness is associated with it. Tenderness: just to the right of the median line slightly below xiphoid. No distention or tenderness in the cæcal region. Stomach: by percussion reaches below the umbilicus and well over beyond the median line to the right side.

X-ray series: Stomach: pulled well over to the right and fixed high up beneath the liver. No deformity of stomach or duodenum. No indication of ulcer. Peristalsis is active. Slight retention at three hours. Cæcum: seems moderately enlarged.

Operation: 5-16-18. Incision: T. R. R. Findings: There was a strong, double fold of peritoneum running from the cystic duct and proximal gall-bladder downward across to duodenum and pylorus to transverse colon. This fold caused high fixation and an obvious sharp kinking of the duodenum. Stomach: pylorus on the anterior wall was irregular; wide cicatrix with much thickening of the underlying wall. The crater of the ulcer could be palpated. There was perihepatitis on the under surface of the right lobe of liver. There were omental adhesions to the old appendix scar which were not causing any apparent disturbance. Procedure: Hepato-duodenal membrane was divided and duodenum mobilized downward. Ulcer was excised and the wound closed by three layer sutures. Convalescence: Prompt and satisfactory.

Result: Since operation there have been several periods of apparent recurrence and healing of ulcer. At present, three years, seven months after operation, he is in very good condition. Has gained weight and color. Capacity for work has greatly increased. Appetite is good; no constipation. Is troubled slightly with gas. Much improved, three years, seven months.

(It is probable that the symptoms in this case were due more to the ulcer than to membrane development, but it was there and the case is included to indicate the variety.)

CASE XXX, S. M., F. Twenty-four years. Began to have digestive trouble when nine years old. One year later had gangrenous appendicitis, peritonitis and was operated upon. When eighteen years of age began to have attacks of grand mal associated with nausea and vomiting which persisted for two days after the attack, sometimes the temperature would rise to 102° F. At first the attacks

came at four to six months apart, but gradually increased in frequency until at the age of twenty-four they occurred for two to three days in succession at intervals of two or three weeks. During the intervals her appetite was good, and the bowels somewhat constipated. She had much belching of gas and frequent epigastric pain. She was always depressed and irritable. Her periods were regular and normal.

P. Ex.: She is of medium size, well nourished, brunette, but pale, and with a pasty complexion and acne. There is excessive development of hair on the head, face and abdomen. Gastric contents, stools, urine and blood show nothing abnormal. Protein skin tests—negative. Abdomen shows the appendix scar, oblique, in the right lower quadrant. There is persistent tenderness over the cæcum which is distended with gas, most marked along the inner side of the scar. Also there is marked persistent tenderness to right of median line a little below the xiphoid. Stomach is enlarged and distended with gas.

X-ray series: High fixation of duodenal apex; deformed cap; no evidence of ulcer. Stomach: dilated, fish-hook type; slight four-hour retention; peristalsis somewhat atonic. Slight ileac stasis. Cæcum moderately dilated; retains barium unduly long; somewhat irregular in outline. Ascending colon seemed constricted at about its middle. Gall-bladder, sella turcica, and teeth negative. Pre-operative Diagnosis: Hepato-duodenal membrane. Adhesions.

Operation: 5-30-18. Incision: T. R. R. Three cm. above navel. Findings: Hepato-duodenal membrane 3 cm. wide, holding duodenum high, fixed and kinked at apex. Stomach: somewhat dilated; otherwise negative. Dense adhesions between appendix scar, cæcum and omentum. Cæcum moderately dilated. Right edge of omentum passed obliquely across front of ascending colon, to which it was densely adherent, to upper end of old incision; it caused marked constriction of ascending colon. Gall-bladder normal except for above membrane. Liver and kidneys normal. Uterus, infantile. Ovaries, normal. Procedure: Hepato-duodenal membrane divided, duodenum mobilized downward 5 cm. Adhesions carefully separated; damaged omentum resected and stump inverted. Convalescence: Uneventful, except for "attacks" on the twelfth, nineteenth and twentieth days. On the twenty-first day she left the hospital "feeling better than for years." Seven months later she felt free from depression, her skin was clear, her color pink. She felt perfectly well in every way. Attacks came at irregular, longer intervals, were never severe and were not followed by gastric disturbance or depression. Appetite is good; digestion is perfect, with larger quantity and variety of food than was ever before possible. Nine months after operation a barium series showed marked improvement in stomach, duodenum, cæcum and ascending colon. Not quite three years after operation she developed distress in upper abdomen; fluoroscopy showed stomach, first and second portion of duodenum in good position and freely movable; dependent duodenum (third and end of second portions) was dilated and there was evidence of obstruction at the duodeno-jejunal angle.

Operation: By another surgeon: 6-9-1921. Incision: vertical right rectus near median line. Findings: Stomach: normal. Pylorus and duodenum suspended from anterior edge of liver by flexible adhesions about 3 cm. long, allowing free mobility without kinking or obstruction. Adhesions were present between omentum and scars. No constriction of colon. Procedure: Adhesions divided. Duodeno-jejunostomy. Later information lacking. Result for two years, nine months. Perfect relief of digestive troubles.

(Examination of the original barium series shows some dilation of dependent duodenum, but at that time its significance was not generally appreciated, as it is at the present time.)

CASE XLIV, E. B. S., F. Fifty-one years. Always frail. At twelve years jaundice with much digestive distress for several weeks. Then comparatively

well until twenty-one years, since when she has had much digestive trouble, distress and a "sense of dragging" in the upper abdomen, belching of gas, no nausea or vomiting; frequent flatulence; moderate constipation; very fickle appetite. At first these troubles came in attacks lasting for several weeks, followed by comparative relief for a few months. Gradually these attacks have become more frequent, more persistent and more severe, the distress being most in the right upper quadrant. No jaundice, no vomiting. Sense of dragging in epigastrium constant without relation to food. In last two years loss of twelve pounds, and great depreciation in strength. Very nervous. Occasional sharp headaches. Heart irregular with attacks. Almost completely disabled. No urinary disturbances. Periods began at twelve, irregular, profuse, some pain; ceased at forty-eight.

P. Ex.: Tall, slender, sallow. Skin dry and flabby. Pulse 80, regular, fair quality. Hæmoglobin, 90 per cent.; R. C., 3,190,000; B. P., 135 mm. Rough mitral systolic murmur, no decompensation. Lungs, urine, etc., negative. Abdomen: distended with gas, very tympanitic except for dull note over gall-bladder, which seems to be distended, palpable and slightly tender. Elsewhere no tenderness.

X-ray series: Stomach: marked fish-hook type; descending into true pelvis; seven-hour retention. Duodenum: apex at level of lumbar iv in erect posture; one-half vertebra higher in prone posture (fixation). No deformity suggestive of ulcer. Duodeno-jejunal angle is at level of lumbar iii, *i.e.*, higher than apex. It is not tender and shows no obstruction. Liver shadow is unusually low, accounting for low fixation of duodenal apex. No indication of gall-stones. Cæcum inverted; and appendix, beneath liver, is segmented and tender to pressure. Some stasis in cæcum and ascending colon. Pre-operative Diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 2-3-1919. Incision: T. R. R. just above navel. Findings: Right edge of liver just below right iliac crest. Liver and gall-bladder normal except for position; also membrane. Hepatic flexure held in contact with fundus of gall-bladder by membrane. Inverted cæcum and appendix to outer side of gall-bladder just beneath right lobe of liver, but not adherent to it, being held up by peritoneal folds fusing with peritoneum in front of right kidney. Ileocæcal valve on postero-external aspect of inverted cæcum. Pylorus and first portion of duodenum held in direct contact with gall-bladder and cystic duct by hepato-duodenal membrane which caused fixation, compression and angulation. Stomach: enlarged but showed no sign of intrinsic disease. Duodeno-jejunal angle: normal. Kidneys: normal except for increased mobility. Uterus: small. Ovaries: small and fibrotic. Procedure: Appendectomy. Mobilization of cæcum and terminal ileum to their normal site. Division of hepato-duodeno-colic membrane with mobilization of hepatic flexure; and duodenum downward 6 cm. Raw surfaces covered in. Convalescence: Uneventful.

Result: Two years, ten months: Some flatulence, occasional constipation, fine appetite; very few restrictions as to food; much improved in color; and very greatly in strength. Much improved, two years, ten months. (Practically cured.)

(Her brother-in-law states that "she is entirely made over, she was always sick, self-centred and a nuisance to everybody. She is now well, attending to her own duties, and very helpful to all those about her." She ought properly to be classed as a cure in spite of her occasional digestive discomforts.)

CASE XLVII, J. F., M. Forty years. Frequent bilious attacks as a boy. Then well as to digestion until after twenty-eighth year when he had typhoid and relapse, causing thirteen weeks' stay in bed. Since the typhoid there have been digestive disturbances, usually in long attacks with occasional short intervals

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of relief. At first the difficulty was chiefly from gas distention with only moderate pain and no constipation, and no nausea. There has been marked increase in the disturbance, especially during the last eight months, preceding operation, and increasing constipation, occasional nausea, more pain, occasional headaches, and a marked loss of energy and capacity, both mental and physical, have been added to the clinical picture. Extreme nervousness, irritability and loss of self-control have developed. He is a moderate user of tobacco and alcohol.

P. Ex.: He is a large framed, well-nourished man of good color. Heart, lungs, urine, gastric contents and stool showed nothing of moment. Abdomen: somewhat distended; tympanitic over cæcum, ascending colon and beginning transverse colon; almost flat to percussion on the left side; moderate tenderness beneath right ninth and tenth costal cartilages, and over the appendix. Otherwise negative.

X-ray series: Stomach: smaller than average; shows no sign of ulcer; peristalsis hypertonic. Duodenum: apex, erect posture, at lumbar ii, prone posture one-half vertebra higher; immovable during fluoroscopy. Terminal ileum curled upon itself behind cæcum. Appendix: visualized clearly; freely movable. Cæcum and colon: no stasis. Gall-bladder and urinary apparatus showed no calculi. Pre-operative diagnosis: Hepato-duodenal membrane. Chronic appendicitis.

Operation: 3-3-1919. Incision: T. R. R. Two cm. above navel. Findings: Stomach: smaller than normal, cow-horn type; walls somewhat hypertrophied; antrum to right of median line and curved sharply back, up and inward to. Duodenum: apex, fixed rigidly 1 cm. below cystic duct, kinked and compressed; by hepato-duodenal membrane running from proximal third of gall-bladder and cystic duct to first portion of duodenum, involving apex and running across in front, membrane rigid. Gall-bladder normal except for membrane. Liver normal except for thickened capsule on under surface right lobe. Duodeno-jejunal angle, transverse and descending colons, normal. Terminal ileum freely movable. Appendix: long, irregular; tip fibrous for 3 cm. Kidneys and pelvic contents negative. Procedure: Hepato-duodenal membrane divided. Duodenum mobilized downward 4 cm. Appendix: removed, stump inverted. Post-operative period was stormy; temperature was around 103 for the first four days; there was marked abdominal distention from the start, which was very refractory to treatment for seventy-two hours, but then diminished considerably; pulse, 130; respiration, 26; râles at right base. On the third day there was flatness up to the sixth rib posteriorly. After the fifth day the temperature descended gradually to 101; flatulence much less, pulse and respiration much less embarrassed. Tenth day sutures removed; wound free from tenderness or swelling; apparently perfect primary union. Fourteenth day: discharge from outer angle of wound; culture showed colon bacillus. Eighteenth day: temperature again 103.6 and X-ray picture indicated subphrenic abscess, which was evacuated by another surgeon, a quart of yellow, almost transparent fluid being obtained, followed by turbid fluid; culture showed colon bacillus. Convalescence: was then steady and he left the hospital on the thirty-eighth day after operation, his digestive disturbances having disappeared. Pathological report: "Atrophic appendix."

Result: Failure. Still troubled with flatulence, constipation, etc. Failure, two years, nine months.

CASE IV, T. S., M. Thirty-five years old. Absolutely well until twenty-three years old. After eating heartily he went hunting, exercised strenuously, felt epigastric pain, distention and "splashing in stomach." Thereafter, food or drinks caused same trouble, but in increasing degree. For a long time ingestion of fluids caused protrusion of epigastrium, downward dragging, headache, and tremulous weakness. Anorexia. Eats only

two small meals per day from fear of the pain. No vomiting. Always had marked flatulence. No definite constipation. Pain is somewhat relieved by bending forward and pressing against abdomen; also by lying on left side; lying on right side causes pain. He is incapacitated about fifty per cent.

P. Ex.: Small frame, thin, but fairly muscular Japanese. Facies of constant suffering. Lungs, heart, urine: negative. Abdomen: much distended and tympanitic. Stomach: dilated; down to navel; very tympanitic; splashing marked; tender just above navel and increasing upward to mid-epigastrium. Cæcum and ascending colon are distended, tympanitic and tender. Appendix: no localized tenderness.

X-ray series: Omitted for financial reasons. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Appendicitis—chronic(?).

Operation: 7-15-1916. Incision: T. R. R. 4 cm. above navel. Findings: Hepato-duodeno-colic membrane, short and thick, and with an extension to quadrate lobe of liver. Duodenum: fixed high; kinked; compressed. Stomach: greatly enlarged, distended, well into right flank; doubled back on itself to reach duodenal fixation. No intrinsic gastric disease. Duodeno-jejunal angle: negative. Pericolic membrane: well developed, covering whole cæcum and ascending colon, causing compression, kinking, etc. Cæcum: dilated. Appendix: very long; irregular calibre; external to cæcum. Procedure: Hepato-duodeno-colic membrane divided; duodenum mobilized downward 7 cm. Pericolic membrane divided. Appendix removed. Convalescence: Uneventful. Pathological report: Chronic appendicitis.

Result: Four months later had gained 15 pounds, felt much better and able to work well. Nineteen months later—appetite good, could eat three meals per day; all foods; no pain; slight flatulence; no constipation. Much improved, nineteen months.

CASE V, B. C., F. Thirty-three years. Never robust. Weak lungs, chills and fever at fourteen years. For many years subject to cramps and diarrhœa, with increasing depreciation in general health. From twenty-five years of age has spent nearly half her time in bed at various sanatoria, with temporary improvement especially in weight. When twenty-seven years of age, appendix was sought but not found. A retroperitoneal gland was removed which was said to be tubercular. At thirty years of age began to have attacks of unconsciousness followed by severe pain, nausea, and great weakness, which have become gradually more frequent, with much abdominal pain and alternating constipation and diarrhœa between times. No stamina. One hundred per cent. disability. Sense of downward dragging in epigastrium constant; somewhat relieved by crouching forward.

P. Ex.: Just after three months at sanatorium. Small frame; fairly nourished; good color. Heart, lungs and urine: negative. Blood: Hæmoglobin 100 per cent.; R. C., 6,187,000. Pressure, 124/84. Stomach: 100 c.c. retention, three hours after 200 c.c. meal. Achlorhydria. Stool: negative. Abdomen: small appendix scar. Tenderness over cæcum which is distended and tympanitic. Stomach: dilated; tympanitic; tenderness to right of mid-epigastrium.

X-ray series: Stomach: fish-hook; much dilated; down to true pelvis; atonic peristalsis. Duodenum: apex fixed high; sharply angulated; cap distorted. Cæcum: dilated; prolapsed into pelvis. Ileac stasis. Hepatic flexure fixed high near angulated duodenum. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane.

Operation: 10-20-1916. Incision: T. R. R. Four cm. above navel. Findings: Hepato-duodeno-colic membrane, short and rigid, holding duodenal apex fast, causing kinking and compression. Stomach: much dilated; thin walled; over in right side, bent back on itself to reach fixed duodenum. Liver: normal; gall-

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bladder: normal, except for membrane. Omentum: firmly adherent to scar of appendix operation. Pericolic membrane: kinking and compressing cæcum and ascending colon, especially at hepatic flexure. Appendix: small; retrocæcal for 3 cm.; free for 1.5 cm. of tip. No signs of tubercular infection of peritoneum, of intrinsic disease of stomach or intestine, or of pelvic organs. Procedure: Division of hepato-duodeno-colic membrane with mobilization of duodenum downward 6 cm. Appendectomy. Division of pericolic membrane. Convalescence: Uneventful. The day after operation she stated the "sense of dragging" in the epigastrium was gone for the first time in years.

Result: No digestive disturbance, unless greatly fatigued; no restriction in diet. Gained fifteen pounds. Color good. Strength and endurance normal. Does all kinds of household and social duties continuously. Cured, five years, two months.

CASE VI, F. M., M. Fifty years. For over thirty years accustomed to sudden attacks of severe abdominal cramps with nausea and vomiting and temporary total disability, coming at irregular intervals, and having no apparent relation to meals.

There was no indigestion between attacks, the appetite was good and the bowels regular and he was well nourished. When forty-nine years old an attack took the form of typical biliary colic, but was not followed by jaundice or fever. A selected, restricted diet reduced his weight 40 pounds, and almost eliminated the attacks during the next eleven months. During the following month he had two severe attacks and felt weak and miserable all the time. During the last ten days pain and tenderness developed in the right hypochondrium and over the lower ribs, aggravated by deep breathing or using the right arm. Constipation has gradually developed, as has a sense of depression and lassitude. Ordinarily he is a most energetic, persistent worker. The heart shows considerable irregularity when tobacco is used. He has had a chronic cough for several years.

P. Ex.: A man of large size, well nourished, worried and pale. Lungs: chronic bronchitis; no pleuritic friction sounds. Heart: no enlargement; slight systolic murmur at apex. Pulse: regular, 72, and good quality. Urine: normal. Abdomen: prominent; wall fat; marked tenderness over right hypochondrium and lower ribs, also hyperæsthesia. Deep breathing prevented. Tenderness about one-third from the xiphoid to navel. No tenderness over appendix or cæcum. Gall-bladder could not be felt.

X-ray series: Stomach of moderate size, cow-horn shape; marked peristalsis; no retention; no sign of ulcer. Duodenum: cap round with hazy outline; apex fixed high, well to the right and immobile. Gall-bladder: shadow seemed enlarged and contained two shadows suspicious of stones. Hepatic flexure: held high, fixed and angulated. Cæcum and first half of ascending colon greatly dilated. Ileac stasis. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Biliary calculi.

Operation: 11-9-1916. Incision: T. R. R. Three cm. above navel. Findings: Gall-bladder seemed normal in every way and contained no stones. No stones in common duct to be felt. Pancreas: normal to palpation. Liver: normal. Stomach: not large; wall thicker than normal, but otherwise negative. Hepato-duodeno-colic membrane: from the cystic duct and neighboring liver ran to pylorus and duodenum, fixing them firmly against liver and duct, and then down and outward to hepatic flexure. It contained many vertical white threads, was inelastic, held the apex of duodenum high and well back, and caused kinking and compression. This membrane surrounded the cystic duct so that pulling downward on the duodenum caused torsion and angulation of the cystic duct, possibly accounting for the apparent attacks of biliary colic. Pericolic membrane: covered cæcum and ascending colon with thickened bands crossing the middle of ascending

colon and the hepatic flexure. Cæcum considerably dilated. Ileum: negative. Appendix: about 15 cm. long, 1 cm. in diameter; much congested; filled with soft faeces. Procedure: Mobilization of duodenum 10 cm. downward and forward, freeing cystic duct of the traction. Appendectomy. Division of pericolic membrane and bands, freeing colon. Pathological report: Catarrhal appendicitis. Convalescence: For five days persistent hiccup, nausea and regurgitation. Abdomen soft, not tender; bowel expelling flatus. Thereafter improved steadily. Ninth day inner end of wound discharged about 6 ounces of liquefied purulent fat. Infection cleared up in five days by irrigations with Dakin's solution, and healing complete about two weeks later. For three weeks following operation he had some of the old spasms of pain, but they were much less severe and often would be aborted, which had never previously occurred. They gradually faded away. Seven weeks after operation he had gained 12 pounds, looked and felt well, the wound was solid, and he had no pain for three weeks. Three months after operation, subsequent to aggravation of his chronic cough, he developed a hernia, the ends of the rectus being separated 5 cm. On May 30, 1917, under two per cent. novocaine, the hernia was repaired, and has remained solid.

Result: Five years, three months. Some pain; apt to follow high carbohydrate diet. Moderate flatulence and constipation. Appetite excellent; carbohydrate restriction necessary. Color much improved. Capacity for work greatly increased. Much improved, five years, three months.

CASE VII, M. W., F. Fifty-three years. When twenty-three years old had very severe attacks of sick headache, vomiting, photophobia, constipation, etc. Correction of refraction gave some relief. Since thirty-eight years old has had constant distress after eating, a sense of dragging and distention rather than actual pain, followed by sour eructations, headache, and lassitude, mental and physical. Tires very easily. Constipation very troublesome, stools scybalous. The troubles have gradually increased. Menopause at forty-eight; no special disturbance. Dyspnoea on exertion.

P. Ex.: She is a short, over-fat, flabby woman of good color. Marked pyorrhœa with recession of gums. Finger joints enlarged. Heart, lungs, urine: negative. Pulse 72. Abdomen: prominent, fat, tympanitic, showing marked tenderness over the appendix, and slight tenderness in the mid-epigastrium and over the sigmoid.

X-ray series: Stomach: fish-hook type, enlarged; extending to right of median line; showing twelve-hour retention; no evidence of ulcer. Duodenum: apex fixed high and angulated; cap distorted and irregular. Colonic and iliac stasis after seventy-two hours with barium still in appendix. Gall-bladder shows small round shadow, suspicious of stone. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 11-21-16. Incision: T. R. R. Three cm. above navel. Findings: Hepato-duodenal membrane running from near the fundus of gall-bladder to lower border of duodenum near pylorus, which was held firmly against gall-bladder, thus suffering axial rotation as well as high fixation. Duodenum then ran along gall-bladder to cystic duct, being firmly held by membrane. Gall-bladder: normal in every way except for membrane. Liver: normal. Stomach: much dilated; well over into right flank; bent backward and inward to gall-bladder. No intrinsic disease. Pericolic membrane: a firm, broad band ran upward and inward across middle of ascending colon causing marked compression. Cæcum: dilated and somewhat thinned. Appendix: long, distended and much congested. Pelvic organs: infantile; ovaries, fibrotic. Procedure: Hepato-duodeno membrane divided and duodenum mobilized downward 10 cm. Pericolic membrane divided and colon freed. Appendix: removed; stump in-

verted. Convalescence: Uneventful. One week after operation the bowels moved spontaneously for the first time in years.

Result: No pain; occasional constipation and flatulence. Appetite is good. Restrictions as to apples, cabbage-family, and cooked cheese. Very great improvement in general health and capacity to work. Much improved, two years, eight months.

CASE VIII, A. G., F. Twenty-four years. Always frail, and always suffered from indigestion. When nineteen years old the appendix was removed in the hope of relieving the indigestion. After temporary improvement she began to have attacks of cramping pains, nausea and diarrhoea. From twenty-three and one-half years on, the attacks became much more frequent and severe, and were associated with marked distention and tenderness of the cæcal region. Free catharsis causes some relief for one or two days. She was totally incapacitated.

P. Ex.: She is of small size; brunette; well nourished, with marked overgrowth of hair generally; with enlarged thyroid but with no rapid pulse or exophthalmos. Extremely nervous; muscles all undergo tonic spasm on palpation. Heart: systolic murmur over left second space. Lungs: negative. Respiration: thoracic in type. Abdomen: Right, oblique, appendix scar. Cæcum: distended and very tender, dull to percussion. Remaining colon, tender, tympanitic. Gastric contents: negative.

X-ray series: Thought inadvisable, because of the nervous general condition and the marked abdominal disturbances. Pre-operative diagnosis: Pericolonic membrane constricting colon.

Operation: 2-20-17. Incision: Vertical R. R., mostly above navel. Findings: Omental adhesions to appendix scar and to inner side of colon just above ileum, causing rotation of colon forward and outward. Pericolonic membrane covered entire ascending colon, its upper edge was much thickened and caused compression, kinking and marked obstruction near hepatic flexure. Hepato-duodenal membrane of moderate size from proximal gall-bladder to first part of duodenum. Gall-bladder normal except for membrane. Liver: small and thin (patient also quite small). Stomach: normal. Ilium: normal. Cæcum: not flabby or dilated. Pelvic organs: normal. Procedure: Omental adhesions separated from appendix scar and colon. Damaged omentum resected and raw stump inverted. Pericolonic membrane divided and colon mobilized. Hepato-duodenal membrane: divided and duodenum mobilized downward 2 to 3 cm. (This membrane was not causing very obvious disturbance but was divided on general principles.) Convalescence: Uneventful. The old attacks disappeared.

Result: Two years, five months, no pain; no flatulence; good appetite; no dietary restrictions; has gained weight; improved in complexion. Completely recovered health and endurance. Cured, two years, five months.

CASE IX, W. F. R., M. Fifty-five years. Always perfectly well until forty-nine years old, when accident caused loss of left upper extremity and persistent pain in left brachial plexus; this pain has persisted in spite of root section. When fifty-three years old began to have severe pain and great bloating after eating. This trouble increased so much that he ate only tea and toast from fear of the pain. Constipation became very aggravated. During the two months preceding operation he lost fifteen pounds, although he had been very thin for years.

P. Ex.: He is emaciated, pale and haggard. Heart and lungs: negative. Gastric contents: negative as to chemistry and blood. Stools: negative to blood. Abdomen: distended, tympanitic, especially over the cæcum, no tender areas anywhere.

X-ray series: Stomach: dilated, fish-hook type, atonic, six-hour retention, no ulcer. Duodenum: high fixation; angulation at apex; cap not deformed; no ulcer. Cæcum and first half of ascending colon dilated but above that to

well beyond hepatic flexure colon appeared constricted and twisted. Appendix: not visualized. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane.

Operation: 3-19-17. Incision: T. R. R. just above navel. Findings: Stomach: greatly dilated, distended, reaching over to right flank and bending backward, inward and upward to duodenum. No evidence of ulcer. Duodenum: apex adherent to under surface of liver to left of cystic duct. Hepato-duodenal membrane: from cystic duct and proximal gall-bladder to apex of duodenum, down duodenum to pylorus, greater curvature and so on, to transverse colon, which was firmly bound to stomach for 3 cm. Liver and gall-bladder: normal except for membrane. Pericolic membrane: Broad, firm band (4 cm. wide) ran downward and inward across middle of ascending colon, kinking and compressing and twisting it. Appendix: shrivelled and adherent throughout. Procedure: Duodenum mobilized downward 6 cm. Pericolic membrane divided and colon mobilized. Appendix: removed, stump inverted. Pathological report: Chronic catarrhal appendicitis. Convalescence: Uncomfortable. Wound broke down on fifth day and healing was not complete until thirty-fourth day. For first few days there was much flatulence and pain, but these yielded and soon his digestion was comfortable and his constipation almost disappeared.

Result: Two years, ten months. No pain; some gas; slight constipation; appetite good; no restrictions. General health and strength much better. Much improved, two years, ten months.

CASE XIII, A. V. P., F. Twenty-five years. For many years she has been subject to attacks of headache, nausea, vomiting and abdominal pain. Between attacks there is always discomfort, flatulence and constipation. The discomfort is chiefly in the right side. The attacks increase in frequency and severity, and are likely to be precipitated by indiscretions in diet. They cause a certain amount of apprehension and disability. In other respects she is very well.

P. Ex.: She is of small frame, quite fat, and of good color. Heart and lungs: negative. Blood: Hæmoglobin, 100 per cent.; red blood-cells, 5,280,000. Abdomen: distended and tympanitic, especially on the right side. Tenderness along the entire colon, but especially along the ascending colon. Localized tenderness over the appendix area and just to the right of mid-epigastrium.

X-ray series: Taken three years before above examination. Showed "disturbances about the cæcum, but nothing wrong with stomach or pylorus." Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 8-4-17. Incision: Vertical R. R. Findings: Stomach: somewhat dilated; fish-hook; no ulcer. Duodenum: apex fixed high; kinked, compressed by. Hepato-duodenal membrane: extending half way to fundus of gall-bladder, running to first portion of duodenum. Liver and gall-bladder: normal. Pericolic membrane: about 7 cm. broad, running downward and inward across middle of ascending colon and clamping it back against body wall, causing much obstruction. Cæcum: somewhat dilated; rolled forward and upward over the lower edge of pericolic membrane. Appendix: 5 cm. long and about 2 mm. thick, bound to cæcum. Hepatic flexure: fell forward and downward over the upper edge of pericolic membrane, causing a double twist-kink of the gut. Pelvic organs: quite small, but otherwise normal. Procedure: Mobilization of duodenum downward 7 cm. Mobilization of ascending colon. Appendectomy. Pathological report: Chronic oblit. appendicitis.

Result: Complete cure. Cured, four years, four months.

CASE XV, E. H. W., F. Forty-two years. All her life she had been subject to epigastric pain and digestive discomfort. Chorea and endocarditis as child.

When twenty years old had an attack of severe pain in right lower quadrant, lasting nearly a week. These have recurred about twice a year since. When thirty-three, heart lesion became serious and has given much trouble since. When forty the digestive attacks became much more frequent and severe and the cæcal region would balloon up. She developed definite colitis with alternating constipation and diarrhœa. Her diet became very restricted, she lost weight and became totally incapacitated. She has always felt a dragging sensation in upper abdomen.

P. Ex.: She is of small frame, fairly nourished, pale and haggard. Very neurotic but optimistic. Lungs: negative. Heart: mitral, systolic, lesion; poorly compensated. Urine: gastric contents; stools: negative, except for mucus in stools. Abdomen: somewhat distended and tympanitic. Tenderness along entire colon, but marked and localized over appendix and to the right of mid-epigastrium. Stomach: seems enlarged downward and to right.

X-ray series: Stomach: fish-hook; no retention. Duodenum: apex high, angulated; deformity of cap but not indicative of ulcer. Cæcum: dilated. Hepatic flexure: fixed high and sharply angulated. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis. Colitis.

Operation: 10-10-17. Incision: T. R. R. just above navel. Findings: Stomach: negative. Hepato-duodenal membrane: out to middle of gall-bladder and down to pylorus and duodenum which were held within 5 cm. of gall-bladder. Gall-bladder and liver: normal. Cæcum: dilated. Appendix: long, large, angulated, retrocæcal. Pericolic membrane: one band fixing hepatic flexure high and angulating it; one band across middle of ascending colon, constricting it. Procedure: Mobilization duodenum downward 7 cm. Mobilization colon and hepatic flexure. Appendectomy. Convalescence: Uneventful. On the first day she states the old dragging sensation was gone from the epigastric region.

Result: Because of the serious heart lesion her general health has been very variable. Four years and two months after operation she had none of her old pains; no flatulence; no constipation or diarrhœa; good appetite and a few restrictions of diet. Color is better, and general health improved. Improved, four years, two months.

CASE XVI, H. J., F. Twenty-four years. She has always had frequent digestive disturbance accompanied by marked constipation since childhood. She was otherwise well. When nineteen she had an attack of severe pain, distention and constipation. There was some tenderness in the right lower quadrant. Appendix was removed. Since operation pains have been much more frequent, much more severe. The stubborn constipation has developed, sometimes alternating with mucus diarrhœa. Her general condition has depreciated more and more until she has become a chronic invalid, almost completely disabled. During the later attacks food has caused pain and nausea so the diet has become extremely limited. When lying down she is comparatively comfortable, but the erect posture always induces pain. During the last year she has lost 25 pounds in weight and has marked loss of stamina. She has frequent headaches.

P. Ex.: She is tall, rather slender, of fair color. Skin is flabby, dry and somewhat parchment-like. Heart and lungs, urine, gastric contents and stool: negative. Abdomen: distended, especially on the right side. Cæcum: distended; quite tender to pressure and can be made to roll and gurgle under the fingers. Tenderness: extends upward to about level of navel. There is also tenderness in the mid-epigastrium and over the sigmoid which is also distended. On percussion the right iliac fossa and up to the edge of the tender area there is flatness. Elsewhere the abdomen is tympanitic. Stomach: seems enlarged.

X-ray series: Reported to have shown high fixation of apex of duodenum. Stomach: somewhat enlarged; fish-hook type. Transverse colon: marked ptosis, and apparently much longer, as a whole, than the average. Hepatic flexure:

fixed and angulated. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Adhesions.

Operation: 11-22-17. Incision: T. R. R. Just above navel. Findings: Stomach: was much enlarged, projected way over to right flank; turned backward, inward and upward to apex of duodenum. Pylorus and first part of duodenum lay in contact with gall-bladder from fundus to cystic duct and was held in close contact by typical, hepato-duodenal membrane: running from middle of gall-bladder to cystic duct. Except for the membrane the stomach, pylorus, duodenum, gall-bladder and liver were normal. Cæcum: was much dilated, rather thin and pale. It was not adherent to the old appendix scar. There was one adhesion between the omentum and the old scar. Pericolic membrane: involved the ascending colon from the hepatic flexure, which was kinked and compressed, down to the lower part of the ascending colon somewhat above the cæcum. A thick transverse band crossed the middle of the ascending colon, compressed it tightly and kinked it strongly. Pelvic organs: normal in every respect. Descending colon and sigmoid: normal. Procedure: Mobilization of duodenum and pylorus downward about 5 cm. Omental adhesion separated. Pericolic membrane divided and colon mobilized. Convalescence: For the first thirty-six hours there was considerable nausea and vomiting. Headache followed for two days afterward. Considerable abdominal pain for first five days. After the five days she was comfortable except for occasional attacks of griping pain, which were relieved by belladonna. There was stubborn constipation in spite of irrigations or cathartics. Temperature for first few days became subnormal; remained almost constantly at 96.2, with pulse varying between 56 and 60. She feels tired out constantly. Has no real appetite. Wound healed by primary union.

Result: Four years, one month. Much improved. Has occasional abdominal pain but never severe. Occasional flatulence. Constipation is still present. Appetite variable but can eat a greater variety than before. Has gained a few pounds in weight. Much improved in color. General health is much improved. Rarely has headache. Since operation she had had influenza and two children and in spite of that has shown marked improvement. Much improved, four years, one month.

CASE XVII, W. T. J., M. Twenty-seven years. He was perfectly well in every way until twenty-six years old when he developed a nervous breakdown. He was beginning to get in shape when he had two successive attacks of influenza in January, 1917. His neurasthenia recurred. In the fall when much improved he had entered a training camp, but the strenuous life soon caused another breakdown and he was discharged from the service. He has had no pain in the abdomen, but for over a year has had much flatulence and a sense of heaviness and dragging after eating. The bowels have been regular without drugs.

P. Ex.: He is tall, slender, dark complexion, looks slightly pale and depressed. He is very nervous and hysterical. Heart, lungs, gastric contents and stool: negative. Urine: negative, except for a faint trace of albumin. Blood-pressure: 144 mm. Abdomen: Normal in contour and not much distended. There is normal tympany. There is very definite localized tenderness in the appendix region. Moderate tenderness in the mid-epigastrium.

X-ray series: Stomach: slightly enlarged; fish-hook type; projects well to the right of median line and seems fixed. Peristalsis is vigorous, and stomach was empty in three hours. Apex of duodenum is fixed high and is angulated. Cæcum: conical in shape and is in the true pelvis. Hepatic flexure: somewhat high and angulated. No sign of ulcer of stomach or duodenum, or of gall-stones. Appendix: not visualized. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 11-27-17. Incision: T. R. R. Two cm. above navel. Findings: Stomach: enlarged; well over to the right, backward, upward and inward to duodenum. Apex and first part of duodenum: fixed high, kinked and compressed. Otherwise, stomach, pylorus and duodenum were negative. Hepato-duodenal membrane: about 4 cm. wide, from gall-bladder and cystic duct to first portion and apex of duodenum, allowing only 1 cm. mobility. Pericolic membrane: along most of the ascending colon with thickened mid-portion running across middle of ascending colon. It constricted the gut and kinked it definitely. Cæcum: moderately dilated. Appendix: quite irregular in calibre, about 8 cm. long. It was not adherent. Procedure: Mobilization of duodenum downward 5 cm. Mobilization of ascending colon by division of pericolic membrane. Appendectomy. Convalescence: Uneventful. Free from pain, nausea or any disturbance. Recovery of strength, weight, color and nervous energy. Mental balance very rapidly recovered.

Result: Four years. Absolutely well in every way. Has no digestive disturbance of any kind. Gained thirty pounds in weight with much improvement in color. He states that his general health and capacity for work have increased "1000 per cent." He also states that his whole mental attitude is now normal and steady. Cured, four years.

CASE XVIII, M. N., F. Thirty-nine years. As a child she was subject to attacks of pain in the right lower quadrant. She had occasional constipation and a fickle appetite. She has had two children and perineorrhaphy following the second one. Since a definite attack when she was thirty-four years old there have been frequent repetitions. Often the pain lasts for only ten or fifteen minutes, but the side would be sensitive to pressure and the pain would recur during a week or so whenever she walked or exercised. She has had frequent headaches and there has been marked loss of general health and strength as well as in weight. Her physician reported that she had developed definite psychosis during her thirty-ninth year. She is likely to do things very vigorously and persistently for a few days and then go to pieces for one or two weeks.

P. Ex.: She is tall, sallow, weighs only 110 pounds. She is nervous, irritable, liable to obsessions; very energetic up to a point of exhaustion. Heart, lungs, urine: negative. Abdomen: flat; scaphoid and wall seems devoid of fat but muscles are well developed. Stomach: somewhat enlarged and tympanitic. Distinct tenderness localized in appendix area. Cæcum: dilated and gurgles with gas whenever compressed. Tenderness: just below the ninth costal cartilage, right side. Bimanual examination of the pelvis showed nothing.

X-ray series: Omitted for various reasons. Pre-operative diagnosis: Chronic appendicitis. Jackson's membrane.

Operation: 12-4-17. Incision: T. R. R. Two cm. above navel. Findings: Stomach: Freely movable; greatly distended with gas, well over into the right side. Duodenum: apex adherent to cystic duct and proximal gall-bladder (hepato-duodenal membrane), and in addition by some very firm, thick adhesions to the under surface of liver 2 cm. to the right of gall-bladder. No ulcer could be made out in either the duodenum or stomach. Gall-bladder and liver: normal otherwise. Right kidney: normal, but more freely movable than usual. Cæcum: free, somewhat dilated. Appendix: thickened, retrocæcal. Pericolic membrane: involved ascending colon from just above the cæcum to the hepatic flexure which was kinked and compressed by a strong, short band. Pelvic organs: uterus anteverted, freely movable. Right ovary: very fibrous and showed a hard, nodular growth at the hilus. Left ovary was a single cyst. Procedure: Mobilization of duodenum downward 4 cm. Mobilization of ascending colon and hepatic flexure. Appendectomy. Oöphorectomy through Pfannenstiel incision. Convalescence; Perfectly uneventful.

Result: Four years. Occasional abdominal pain, never severe. Some flatulence; no constipation. Appetite, variable. No restriction of diet. Has gained sixteen pounds in weight. Color much improved. Capacity for work has "enormously" improved. In addition, psychosis and nervous instability have disappeared. She is now a perfectly normal woman. Much improved, four years.

CASE XX, D. C., F. Twenty-three years. She had had so-called nervous indigestion at various periods in her life. Tonsils were removed at seventeen years because of repeated attacks of rheumatic pain. These rheumatic pains were attributed to some focus of infection, but examinations of the various nasal sinuses, teeth and throat show no focus. Appendix had been removed several years ago. The only thing left to lodge infection was, therefore, the gastro-intestinal tract and her history was not very conclusive. There had been various disturbances of digestion associated with flatulence, constipation and a variable appetite.

P. Ex.: She is a young woman of medium height, very well nourished, good color. Heart, lungs, mouth, throat, teeth, urine, gastric contents, stool: negative. Abdomen: appears normal. There is moderate distention with gas. Marked tenderness on the inner side of her short, oblique appendix scar. Marked tenderness in about the middle of ascending colon. Also localized tenderness in the mid-epigastrium. Otherwise abdominal examination is negative.

X-ray series: Stomach: considerably enlarged, much ptosed, fish-hook type. Peristaltic waves were atonic. Marked retention after eight and one-half hours, and for the first three hours almost none of the barium was discharged. Duodenum: first portion much enlarged but without other deformity. It is fixed in a high position. Cæcum: dilated. Some stasis in ileum and cæcum. Appendix: not visualized. Transverse colon: elongated and ptosed. There is evidence of constriction in the hepatic flexure, which is, however, only slightly above the iliac crest. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolonic membrane.

Operation: 1-30-18. Incision: T. R. R. Findings: Stomach: greatly enlarged; pushed over to right and then bent backward, inward and upward. Walls were somewhat thinner than normal. Duodenum: apex was fixed high by short and very thick free edge of lesser omentum which extended slightly onto proximal end of gall-bladder. This membrane was very vascular. Also there was an extension which passed across the front of first portion of duodenum to hepatic flexure which it helped to suspend and kink. Liver and gall-bladder: normal. Cæcum: much dilated. It was somewhat adherent posteriorly to iliac fossa. Pericolonic membrane: covered cæcum and ascending colon. One thickened band passed across the colon just above cæcum and the second one passed transversely across the ascending colon just below the hepatic flexure and ran to beginning transverse colon so as to sharply angulate the hepatic flexure, also both limbs of gut just below the hepatic flexure. Kidneys and pelvic organs: normal. Procedure: Mobilization duodenum downward 4 cm. Mobilization cæcum, ascending colon and hepatic flexure. Convalescence: Uneventful.

Result: Occasional abdominal pain but of a different kind, troubled with flatulence; some constipation; appetite very good. No restriction of diet. Gained ten pounds in weight. Improved in color. Her general strength is much better. Some little time after operation she had much pain in the back and it was found that there was some disturbance of dorsal xi and xii of probably tubercular type. For this she has been wearing a brace, and it is still causing some disturbance. Much improved, eighteen months.

CASE XXII, E. S. W., M. Fifty-five years. Always perfectly well until fifty-three and one-half years old. At that time he had an attack of vertigo with nausea, vomiting, violent diarrhoea and some temperature. Absolutely no

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further trouble until fifty-five years old. On February 8, 1918, he awoke in the morning with a dull, aching pain in the epigastrium. No nausea or diarrhoea; after two hours the pain ceased, but he was exhausted for three days. Nine days later he walked three miles in the cold and ate a hearty dinner. Awoke at one o'clock in the morning with pain, which grew steadily worse until he was given a hypodermic. The next morning temperature was 104. Thirty-six hours after the onset there was distinct jaundice both of the skin and conjunctiva. There was very marked prostration. He has never had any constipation and says he has never had indigestion. His family doctor states that he is always troubled with some flatulence and discomfort because he leads a very sedentary life and is inclined to over-eat.

P. Ex.: Large man, well nourished, fair color, but slightly icteric. Teeth: good condition, but there is some recession of the gums. Heart, lungs: normal. There is marked accentuation of the aortic second sound. Blood-pressure, 188/114. Urine: shows faint trace of albumin, considerable bile coloring and hyaline casts. Abdomen: prominent; quite fat; no tenderness can be made out anywhere. Just below the ninth and tenth costal cartilage it seems distended. Gall-bladder can be felt; also percussion shows dullness and flatness in the same area. Edge of the liver could not be made out. Appendix: no tenderness. Blood examination: negative.

X-ray series: In gall-bladder region shows shadow the size of a large egg. Shows no shadow of stone or stones. Pre-operative diagnosis: Cholecystitis with biliary calculi.

Operation: 3-16-18. Incision: T. R. R. Three cm. above navel. Findings: Stomach: enlarged, crowded well over to right of median line, passed upward, backward and inward to duodenum. Duodenum: apex held high and kinked by membrane. Gall-bladder: somewhat distended, tense and rather larger than normal. No stones were in it. Toward the cystic duct there was a projection of liver 8 cm. long, 4 cm. wide and not quite 1 cm. thick folding down around the left side of the gall-bladder nearly to its lower median line. From this projection of liver a firm peritoneal membrane passed to the duodenum which it held very firmly, close up under the liver. This membrane also passed to the cystic duct and caused a sharp kink in it. Pylorus and stomach: normal except for the dilation. Gall-bladder: opened and exposed, dark bile was obtained but there were no stones. Mucous membrane looked perfectly normal. Wound in gall-bladder closed. Common duct and pancreas: showed no evidence of stone or other disturbance. Liver: seemed normal in every way. Cæcum: somewhat dilated. Appendix: free. Right edge of omentum ran downward and outward, its base passing around the hepatic flexure and down the ascending colon. It covered practically the whole ascending colon and was adherent to parietal peritoneum along outer side of colon. Procedure: Mobilization duodenum downward about 5 cm. Omentum was separated from ascending colon and cæcum and from adhesions to external parietal peritoneum with resulting release of ascending colon. Appendectomy. Because of opening and suturing of gall-bladder a small cigarette drain was passed through the outer angle of the wound. This was removed on the second day. Convalescence: Uneventful, but somewhat slow because of the physical prostration preceding operation.

Result: Three years. After the first few weeks he has been perfectly well in every way. Has recovered his old-time vigor and has absolutely no digestive disturbance. Cured, three years.

CASE XXIII, E. S., F. Twenty-two years. Typhoid when ten years old. Headaches frequent ever since. Periods began at fourteen; regular, scanty, pain at start. When seventeen years of age she became fatigued very easily, and lost weight and color. When nineteen years old she had to give up college because of

fatigue, constipation, pain and flatulence. Chronic appendicitis was diagnosed and the appendix removed. Recovery was slow and there was no relief whatever but the symptoms were aggravated, and for about a year the attacks of pain, nausea, flatulence and constipation varying in severity and frequency almost completely disabled her. The attacks of pain have lately been associated with diarrhoea. She has become very nervous and "jumpy" and often has vertigo. The pain has gradually become most definite in the right lower quadrant.

P. Ex.: She is a good sized, somewhat fat, pale young woman. Heart, lungs, urine and blood: normal. Abdomen: somewhat prominent, and tympanitic; tender over the cæcum, gall-bladder and just to the right of the mid-epigastrium.

X-ray series: Stomach: fish-hook, dilated markedly; not emptied until four and one-half hours. Peristalsis active; no evidence of ulcer. Duodenum: apex fixed high, cap small and somewhat irregular but not suggestive of ulcer. Stasis: in ileum marked at 8.5 hours; in cæcum and ascending colon at 36 hours and 48 hours, respectively. Cæcum: dilated; often in true pelvis. Transverse colon: ptosed, dips into true pelvis. Hepatic flexure: sinks often to level of iliac crest. Gall-bladder and urinary system: negative. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Post-operative adhesions.

Operation: 3-26-18. Incision: T. R. R. Two and five-tenths cm. above navel. Findings: Hepato-duodeno-colic membrane from gall-bladder and cystic duct to pylorus and beginning duodenum, holding them fast beneath liver and to transverse colon. Stomach: deflated; of moderate size; no ulcer. Adhesion: inflammatory; from the under surface of quadrate lobe to peritoneum overlying vena cava. No origin discernible. Omentum: adherent to appendix scar. Pericolic membrane: covered entire ascending colon, the upper end of which made one complete loop behind the membrane at the hepatic flexure. Pelvic organs: infantile. Lymphadenitis: retroperitoneal in ileocæcal angle. Procedure: Mobilization duodenum downward 6 cm. Mobilization ascending colon and freeing of loop. Separation of omental adhesions. Removal of some lymph-glands. Pathological report: Tubercular lymphadenitis with calcified areas. (Healed?) Convalescence: Uneventful.

Result: At nine months tremendously improved; had gained much in weight, color and energy and was back at her studies. At three years, nine months: occasional pain, flatulence and constipation. Appetite very good; no restrictions as to food. As a rule is much better than before operation. Much improved, three years, nine months.

CASE XXIV, G. S., F. Forty-four years. Has always had digestive disturbance but paid little attention to it. Periods began at twelve, always irregular, scanty, but without pain. When forty-two had several attacks of persistent metrorrhagia spread over the following year. When these finally stopped she had a marked increase in her digestive disturbances with pain, slight nausea and a sense of dragging down the stomach after eating. When forty-four years old she had a severe attack of pain, nausea, vomiting, diarrhoea, with pain and tenderness in the right lower quadrant which lasted a week. Four days later a more severe attack was associated with great abdominal distention, with chilly sensations. For six weeks had noticed a small tumor in right breast. For nineteen years varicose veins in right leg.

P. Ex.: She is of medium-sized frame, emaciated and pale. Artificial teeth. Throat, heart, lungs, urine and stool: negative. Blood: Hæmoglobin, 80 per cent.; red blood-cells, 4,000,000. Small benign tumor in right breast. Thrombosed varicose veins about inner side right knee. Abdomen: distended with gas, especially on the right side; the walls flabby and thin. Cæcum: is dilated and gurgles on pressure; is tender to its inner side; marked localized tenderness over

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the appendix. Tenderness in mid-epigastrium. Stomach: much dilated; tympanic and prolapsed.

X-ray series: Stomach: marked fish-hook type; lower border in true pelvis; atonic peristalsis; no evidence of ulcer; pyloric end well over in right side. Duodenum: apex fixed high at lumbar ii, and in same position both in erect and prone plates; cap not filled out and irregular, especially in erect posture, but not suggestive of ulcer. Cæcum and ascending colon: dilated. Hepatic flexure: fixed at same level as duodenum apex and obviously constricted, barium not passing it in the first twenty-four hours. Transverse colon: hangs into true pelvis in the forty-eight-hour plate. Appendix: visualized in twenty-four-hour plate. Pre-operative diagnosis: Hepato-duodeno-colic membrane. Pericolonic membrane. Chronic appendicitis. Benign breast tumor. Thrombosed varicose veins.

Operation: 4-8-18. Incision: T. R. R. Just above navel. Findings: Stomach: much dilated; well over in right side; bent sharply back, up and inward to pylorus and duodenum. No ulcer. Liver and gall-bladder: normal, except for membrane. Hepato-duodeno-colic membrane: from middle of gall-bladder backward to cystic duct where the apex of duodenum was held up tight and sharply kinked. The membrane extended down first part of duodenum to lower border of pylorus and then over to beginning transverse colon, where it was continuous with: Pericolonic membrane: extensive; covered whole ascending colon and cæcum; it crossed upper colon and hepatic flexure to transverse colon and joined hepato-duodeno-colic membrane causing a U-shaped bend of the transverse colon behind the veil with triple angulation and marked obstruction. Cæcum: dilated; adherent to iliac fossa; covered by pericolonic membrane. Appendix: moderate size; adherent. Pelvic organs: negative. Right kidney: rather large. Left kidney: rather small. Procedure: Mobilization of duodenum downward. Mobilization of cæcum and colon. Appendectomy. Removal of breast tumor. Removal of varicose veins. Convalescence: Uneventful.

Result: No pain; no flatulence; no constipation; good appetite; no restrictions in diet. Has gained weight, color and strength. Cured, fifteen months.

CASE XXV, C. W., M. Sixty-five years. For many years indigestion with colicky pains and flatulence, but no constipation. At sixty years strained his back, and always weakened since. At sixty-two years digestive trouble became progressively worse, with increased pain, flatulence and constipation which became obstinate, anorexia, and loss of twenty pounds in two months. There was increasing weakness. Never vomited, never passed blood and has never had any urinary disturbance.

P. Ex.: He is of good-sized frame, muscular, well nourished and of good color. Heart, lungs, urine and blood were negative. Abdomen: distended; tympanic; muscles strong and firm, tender over the cæcum (which is not distended), over the gall-bladder region, in the mid-epigastrium and in the right costo-vertebral angle. No growth can be made out anywhere.

X-ray series: Stomach: not enlarged; peristalsis vigorous; has passed seventy-five per cent. of meal in two hours, no sign of ulcer or malignancy. Duodenum: apex fixed at upper edge lumbar ii and varies scarcely one cm. between erect and prone position. Cap somewhat distorted as though by peri-duodenal adhesions. (Series could not be completed because of patient's condition at the time.) White blood-cells, 12,000; S. L., 23 per cent.; polymorphonuclears, 75 per cent. Rectum: negative. Prostate: moderately enlarged, firm, but not tender. Pre-operative diagnosis: Hepato-duodenal membrane. Possible malignant growth.

Operation: 5-4-18. Incision: T. R. R. Just above the navel. Findings: Stomach: not enlarged; walls somewhat thickened. Duodenum: apex was held close up under cystic duct by hepato-duodenal membrane running from proximal

gall-bladder, and causing high fixation and marked angulation. This membrane did not fuse into the gastro-hepatic omentum as usual but was clearly separated. Pancreas: normal. Cæcum: bound by postero-external adhesions. Appendix: 7 cm. long, bulbous; intensely congested. Pericolic membrane: covered ascending colon; with one thickened band compressing the middle of the gut and another fixing the hepatic flexure high and kinking it. Liver, gall-bladder, transverse colon, splenic flexure, descending colon and rectum showed nothing abnormal. Prostate: somewhat enlarged; firm; not nodular. Kidneys and bladder: negative. Lymphatic glands about the internal iliac vessels on both sides were greatly enlarged and somewhat matted together. No cause could be identified. Procedure: Mobilization of duodenum downward 5 cm. Mobilization of colon and hepatic flexure and cæcum. Appendectomy. Convalescence: Uneventful, except for phlebitis in left calf. Returned home in good condition on twenty-fourth day, with very little digestive disturbance.

Result: After a few weeks pain recurred, especially in lower abdomen; eight months later urinary symptoms appeared; the prostate became nodular and he eventually died of carcinoma of the prostate. Failure.

CASE XXVII, R. T., F. Eleven years. Always athletic; appetite always large. Always subject to car-sickness. Always marked constipation, coated tongue and bad breath. Not much flatulence; occasional nausea but no vomiting. During her eleventh year she had irregular attacks of pain in right side of abdomen.

P. Ex.: She is large and muscular but pale and pasty. Mouth-breather as result of broken nose. Heart, lungs and urine: normal. Abdomen: normal to inspection; tender over cæcum, and especially under right rectus near navel. Sigmoid: spastic but not tender; no tender areas in upper abdomen. Cæcum: dilated and apparently thickened and tender. Liver: edge 3.5 cm. below free border but not tender.

X-ray series: Omitted because of time and expense. Pre-operative diagnosis: Pericolic membrane. Chronic appendicitis.

Operation: 5-11-18. Incision: Intramuscular at level of navel with Weir's modification. Findings: Cæcum: dilated; walls not thickened; filled with putty-like fæces. Appendix: small; adherent; containing several concretions. Pericolic membrane: with one band constricting colon just above cæcum and another angulating and constricting hepatic flexure. Hepato-duodenal membrane: fixing high and kinking duodenal apex. Liver and gall-bladder: normal, except for membrane. Pelvic organs: normal. Procedure: Mobilization of colon. Mobilization of duodenum. Fortunately the membrane was thin and avascular. It was divided but no suturing could be done. Appendectomy. Convalescence: Uneventful.

Result: Complete relief of symptoms; gain in weight and color; no constipation. Cured, three years, seven months.

CASE XXXII, A. L., F. Thirty-four years. Always suffered from great digestive disturbance. No pain but anorexia, nausea, flatulence and obstinate constipation. No headaches. These troubles have increased, especially since the thirty-second year, with frequent attacks of extreme fatigue, and with distinct loss of color and some loss of weight. Since thirty-one had several attacks of influenza. Periods: regular, scanty.

P. Ex.: She is tall, emaciated and pale. Eighty-six pounds weight. Heart, lungs and urine: negative. Blood-pressure, 100/80. Extremely nervous, restless and with muscles twitching. Abdomen: somewhat scaphoid; muscles irritable; tender; over spastic sigmoid; over middle of right rectus three cm. below navel, marked and localized. No tenderness in upper abdomen. No marked flatulence.

X-ray series: Stomach: fish-hook type; down to sacral promontory; 29 cm.

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long, 7 cm. wide; shows fair peristalsis. Empty at six hours. Duodenum: apex; erect, lower border lumbar iii; prone, upper border lumbar ii. Cap deformed, small, and apex sharply angulated. Cæcum and ascending colon: dilated. Hepatic flexure: mobile but always angulated. Transverse colon: prolapsed; in true pelvis; and showing stasis. Appendix: visualized throughout and segmented. Gall-bladder: negative. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 6-6-18. Incision: T. R. R. Two and five-tenths cm. above navel. Findings: Stomach: enlarged, pylorus dilated; otherwise negative. Duodenum: apex fixed high and kinked beneath cystic duct by membrane (hepato-duodenal membrane) running out nearly half way to fundus of gall-bladder. Liver: perihepatitis; upper surface and edge of right lobe. Gall-bladder: normal, except for membrane. Duodeno-jejunal angle; negative. Pericolic membrane: covering cæcum and whole ascending colon; quite thick; and with thick bands running across cæcum, the middle of ascending colon, and especially across hepatic flexure, causing obstruction and kinking. Transverse colon: long and prolapsed; free from adhesions. Appendix: atrophic; subperitoneal against cæcum. Pelvic organs and kidneys: normal. Procedure: Mobilization duodenum downward 6 cm. Mobilization cæcum and colon. Appendectomy. Convalescence: Uneventful but slow.

Result: No pain; occasional flatulence. Moderate constipation. Appetite much better; more general diet. Gained ten pounds. Color improved; general strength improved. Much improved, three years, six months.

CASE XXX, B. M., F. Twenty-nine years. Perfectly well until eleven years old when periods began; irregular, profuse, five to seven days, with much pain. At fourteen years developed rapid pulse and enlarged thyroid; disappearing under treatment. Tonsils removed at this time. At sixteen years had an attack of "appendicitis" but no operation was done. Ever since that time there have been intermittent disturbances of digestion, gradually becoming more frequent and persistent and severe. From twenty-six to twenty-nine years, in addition to the pains, flatulence, and tenderness over the whole right side, there developed headache, occasional nausea, marked pallor and profound fatiguability. She became almost totally disabled. Appetite is fairly good; bowels move without medicine, but the stools are small, occasionally lumpy and with mucus. There is some urinary frequency with discomfort.

P. Ex.: She is of medium size, fairly nourished, pale and pasty with marked acne. Very nervous. Thyroid appears somewhat large. Pulse 80, good quality. Heart, lungs and urine: negative. Abdomen: normal appearance; tympanitic; not tender anywhere on *left* side; moderately tender in mid-epigastrium and over gall-bladder; marked tenderness over cæcum and ascending colon, which are distended, and marked localized tenderness over the appendix.

X-ray series: Stomach: marked fish-hook type; dilated; atonic; with lower edge below sacral promontory. Retention after 4.5 hours; no evidence of ulcer. Duodenum: apex at lower edge of lumbar ii in both erect and prone pictures; cap small in erect, and filled in prone pictures. No evidence of ulcer. Apex angulated. Second portion narrow. Cæcum and ascending colon: dilated below, constricted above, showing 48-hour stasis. Hepatic flexure: fixed high, level of upper border of lumbar ii, near duodenal apex; sharply angulated and constricted. Transverse colon: markedly prolapsed. Appendix: retains barium throughout the series; segmented. Enema shows incompetent ileocaecal valve. Gall-bladder and urinary apparatus: negative. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 6-11-18. Incision: T. R. R. Two cm. above navel. Findings: Stomach: much enlarged; well over in right flank; bent back, up and in to

duodenum. Negative otherwise. Hepato-duodenal membrane: pylorus and duodenum fixed almost in contact with gall-bladder by short membrane from fundus to cystic duct. Duodenum: apex angulated and compressed. Liver and gall-bladder: normal except for membrane. Pericolic membrane: covered cæcum and colon up to hepatic flexure; two thickened bands, one just above cæcum and one at flexure causing elevation, angulation and compression. Appendix: very long, tortuous, with very short mesentery. Pelvic organs and kidneys: normal. Procedure: Mobilization duodenum, downward 6 cm. Mobilization, cæcum and ascending colon. Appendectomy. Convalescence: Uneventful.

Result: No pain; occasional flatulence; and mild constipation; appetite good; eats everything; gained some weight; much improved in color, and especially in endurance. She says she is "made over." Much improved, three years, six months.

CASE XXXIV, R. M. G., M. Sixteen years. He has always been well, except for occasional attacks of indigestion, until fifteen and one-half years old, when he had a sore throat followed by cervical lymphadenitis. Shortly afterward a severe colitis developed and lasted about seven weeks, with the final development of pain in the right lower quadrant, which has persisted ever since. There has been no nausea or vomiting. Some loss of weight, color and stamina.

P. Ex.: He is tall, well developed, slender, and with fair color. Heart, lungs, gastric contents and stool: negative. Urine: 1023, trace albumin, trace acetone, hyaline casts. Abdomen: normal appearance; normal tympany. Tenderness: over sigmoid; marked over appendix; slight in mid-epigastrium.

X-ray series: Stomach: fish-hook type; average size; peristalsis good; almost empty at four hours. No ulcer. Duodenum: apex somewhat fixed; cap normal; no sign of ulcer; some puddling in dependent portion with moderate reverse peristalsis. Slight ileac stasis. Cæcum: moderately dilated. Appendix: visualized throughout examination and tender on pressure. Hepatic flexure: some angulation; fixed high. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis. Possible duodeno-jejunal obstruction.

Operation: 6-17-18. Incision: T. R. R. Two and five-tenths cm. above navel. Findings: Stomach: very much enlarged; pushed over into right side; bent back, in and up to duodenum. Otherwise pylorus and stomach negative. Duodenum: apex fixed high and sharply kinked. No ulcer. Hepato-duodenocolic membrane: extended to fundus of gall-bladder and ran directly to hepatic flexure, which was held against gall-bladder and sharply kinked. Remainder of membrane ran to duodenum. Liver and gall-bladder: normal except for membrane. Duodeno-jejunal angle: negative. Pericolic membrane: covered cæcum and ascending colon almost to flexure; two thick bands; one just above cæcum, one just below flexure, causing compression. Cæcum: greatly dilated; very thin-walled, especially external pouch. Appendix: long; irregular calibre; adherent at tip. Kidneys normal. Procedure: Mobilization duodenum downward 5 cm. Mobilization cæcum and colon and hepatic flexure. Appendectomy and plication of cæcum. Convalescence: Uneventful except for cystitis on fourteenth day, which lasted four days.

Result: Perfectly well and strong in every way. Cured, three years, seven months.

CASE XXXV, C. B., M. Thirty-five years. He was well until about thirty years old, when without known cause he became profoundly neurasthenic with marked fear of going about alone, with tremors, perspiration, pallor, etc. Pulse was usually 72 to 80, blood-pressure 125 to 135 mm. even when he said he was about to faint. Had much vertigo. Careful physical examination could not detect a single physical thing that was wrong. During the next five years medical treatment, psychic treatment, rest cures, farm cures, etc., were tried seriatim

ANOMALOUS ABDOMINAL MEMBRANES

with only temporary and slight improvement. His digestive system seemed to be working normally. At thirty-three years he began to have occasional discomfort in the right iliac fossa, becoming more frequent, then pain on moving right leg and hip. These troubles had become constant and annoying by the end of two years, and were associated with vertigo and much flatulence. Appetite was good and bowels slightly constipated. He had been completely disabled (as to work) for five years.

P. Ex.: He is of medium size, well developed, fat, rather pale, nervous and fearful. Heart, lungs, thyroid, urine: negative. Abdomen: moderately distended; wall quite fat; tympanitic everywhere, especially over stomach, which extended down to navel and over to right mammary line. Splashing was easily elicited. Tenderness: along outer edge of right rectus at and below the level of the navel; over the gall-bladder, causing also sticking pain in left upper abdomen. No distention of the cæcum could be made out.

X-ray series: Stomach: fish-hook type; lower border at lumbar iv; peristalsis active; empty in three hours; no indication of ulcer. Duodenum: apex at upper border lumbar ii prone, and lumbar iii erect. Cap well filled. No evidence of ulcer. Adhesions indicated about beginning transverse colon. Cæcum and appendix inverted and beneath liver. Appendix: tender during fluoroscopy. No gall-stones. Pre-operative diagnosis: Hepato-duodenal membrane. Chronic appendicitis. Inverted cæcum.

Operation: 6-19-18. Incision: T. R. R. Findings: Stomach: enlarged, crowding over to right side, then bending back, up and in to. Duodenum: fixed high and sharply kinked, and held firmly against proximal gall-bladder by hepato-duodenal membrane. Cæcum and appendix: inverted beneath liver; they have long mesenteries and are freely movable. Pericolic membrane: involving upper half of ascending colon and crossing to beginning transverse colon, causing kinking and constriction at hepatic flexure. Cæcum and first part of colon bent up around the lower edge of membrane. Procedure: Mobilization of duodenum downward 5 cm. Mobilization of colon and hepatic flexure. Appendectomy. Cæcum tacked in normal position. Convalescence: Uneventful.

Result: With ups and downs he gradually became entirely free from his digestive disturbances and also from his neurasthenic troubles. He returned to business and was doing well. When at his best he contracted encephalitis lethargica. Even so, there has been no digestive disturbance of any kind. Digestive cure, three years, six months.

CASE XXXVII, A. J. M., F. Forty-four years. She has always been subject to some indigestion. When twenty-nine her first child was born; she was badly torn; had a marked prolapse. Her general condition ran down seriously and she lost forty pounds weight. When thirty-three years old she had complete perineal repair and laparotomy for ventral suspension. The appendix was removed at that time. Within a week she developed severe pain and distention on the right side of the abdomen and marked constipation. Ever since that time she has had constant pain in the right side of the abdomen and down the right leg, increased by exercise, and by constipation. Always a few hours after meals the cæcal region becomes distended with gas, which gurgles and starts severe pain in the abdomen and leg. Constipation is obstinate. She seldom has any trouble attributable to the stomach proper. She has become very irritable, nervous, her head is not clear, she fatigues easily, and is much disabled. Her periods are regular, scanty and short.

P. Ex.: She is of medium frame; quite overfat; pale; pasty and with flabby tissues. Nervous, erratic. Heart: shows distinct myocarditis but is working reasonably well. Blood-pressure, 110 mm. Lungs, urine, gastric contents and stool: negative. Blood: Hæmoglobin, 65 per cent.; red blood-cells, 4,000,000.

Wassermann: negative. Abdomen: fat, very flabby, distended with gas, especially right side. No rigidity. Median scar above pubes. Tenderness: over middle of ascending colon; none over cæcum, gall-bladder, or mid-epigastrium. Pelvic examination: Stellate tear of cervix; cyst in anterior lip. Uterus: normal size; freely movable; slightly tender over fundus.

X-ray series: Stomach: marked fish-hook type; lowest point lumbar iv; peristalsis active; empty in three hours; no evidence of ulcer. Duodenum: apex at lower edge lumbar ii, standing and prone, *i.e.*, fixed; sharply angulated. Cap: small, irregular, no evidence of ulcer. Cæcum and ascending colon: dilated; marked stasis at seventy-two hours, distortion toward the hepatic flexure, which was fixed high and in contact with duodenal cap, and showed marked angulation and constriction. Transverse colon: in every plate its shadow was fused with that of ascending colon from the flexure half way to cæcum and then turned at right angle to go to splenic flexure. It and descending colon were small (spastic?) throughout. Following the enema the same conditions were present and after evacuation cæcum and colon still retained much barium. Gall-bladder: no sign of stones. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Post-operative adhesions.

Operation: 6-24-18. Incision: T. R. R. Six cm. above navel. Findings: Stomach: somewhat enlarged; crowded over to right; bent back, up and in, to duodenum. Hepato-duodeno-colic membrane: from fundus of gall-bladder directly to hepatic flexure holding the two in contact and angulating flexure; membrane then ran to duodenum, holding its apex high and sharply angulated beneath cystic duct; one thick band ran down across duodenum to near pylorus. Pericolic membrane: across ascending colon from just above cæcum nearly to flexure, causing compression and distortion. Omentum crossed ascending colon and fused with pericolic membrane. Adhesions: Cæcum to iliac fossa where appendix had been removed. Omentum to old median incision, in which adhesions some loops of small gut were caught. Pelvic organs: normal except for suspension of uterus. Kidneys: normal. Pancreas and duodeno-jejunal angle: negative. Procedure: Mobilization duodenum downward 7 cm. Mobilization cæcum, colon and hepatic flexure. Separation omental adhesions and freeing of coils of small gut. (Tissues all very friable.) Convalescence: Uncomfortable but uneventful. The twelfth day the pain in right leg began to disappear and on the sixteenth day ceased. On the twenty-first day had a normal spontaneous stool for the first time in several years. Two months after operation: no pain in abdomen; only occasional flatulence; had gained ten pounds.

Result: No pain; occasional flatulence and constipation. Color, appetite and general strength greatly increased. Much improved, three years.

CASE XXXIX, A. B., F. Twenty-eight years. For several years subject to bilious attacks, and to pain, distention and belching after meals. Often had severe cramping in lower abdomen, but none since twenty-six years old. Appetite always good. Constipation always. Periods began at thirteen, regular, three and one-half days, moderate, no pain. Always easily fatigued.

P. Ex.: She is large, fat, pale. Heart, lungs, urine: negative. Abdomen: is prominent; very tympanitic, especially over colon, and stomach which seems to reach level of navel. Tenderness: over appendix; over gall-bladder region; and in mid-epigastrium. Pelvic examination: negative.

X-ray series: Omitted for reasons. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis. Gall-stones(?).

Operation: 11-14-18. Incision: T. R. R. Three cm. above navel. Findings: Stomach: somewhat enlarged, otherwise normal. Hepato-duodenal membrane from fundus and whole of gall-bladder to pylorus and up duodenum to its apex which was held fast and angulated just beneath the cystic duct. Pericolic mem-

brane: running upward and inward across colon just above cæcum. Appendix: very long, angulated; irregular in calibre. Liver and gall-bladder: normal, except for membrane; no gall-stones. Hepatic flexure: normal. Kidneys and pelvic organs: normal. Procedure: Mobilization duodenum downward 5 cm. Mobilization colon. Appendectomy. Pathological report: Chronic appendicitis. Convalescence: Uneventful.

Result: Occasional pain; considerable flatulence; some constipation. Appetite good; no restrictions in diet. Much improved in color and in general strength. Much improved, three years, six months.

CASE XL, E. S., F. Forty-six years. Perfectly well and strong until eighteen years old, when she had typhoid. When twenty-one years old she had severe abdominal pain, sharp, radiating to left shoulder and lasting half an hour. Similar attacks came twice a day for a week. Following the pain came nausea. The next bad attack came ten years later when she was thirty-one, and thereafter attacks recurred at irregular intervals, becoming constantly more frequent and more severe. By the time she was forty-one the pain was so aggravated by walking, or other exercise, that she became sedentary. Of late the attacks are associated with marked flatulence, nausea, and diarrhoeal tendency. Also temperature frequently accompanies them, varying from 101 to 105 F. Appetite has been good until lately. Marked loss of strength has occurred in last few months. Subject to occipital headache. Finger joints have enlarged and are painful. Lately the pain has focussed more in the right hypochondrium. There never has been any jaundice, urinary or menstrual disturbance. She is seriously disabled.

P. Ex.: She is of large frame, well developed, well nourished, somewhat pale. Heart, lungs, urine and stools: normal. Abdomen: normal in appearance; respiration is thoracic and abdominal breathing obviously painful. Pressure anywhere over abdomen causes gurgling of gas. Stomach tympany goes to 5 cm. above navel. Tenderness: marked at edge of right rectus on level A. S. S.; over cæcum and ascending colon; especially over gall-bladder, and along transverse and descending colon. Tympany: exaggerated everywhere except just below eighth and ninth right cartilages where there is dulness.

X-ray series: Stomach: fish-hook type, lower edge at lumbar v; peristalsis good; no sign of ulcer; empties in normal time. Duodenum: apex; lower border lumbar i prone, lumbar ii erect; angulated; no sign of ulcer. Descending limb appears to be held to liver by adhesions. Cæcum and beginning ascending colon: dilated; show stasis 48 hours. Appendix: not visualized. Hepatic flexure: narrowed; angulated. Diverticulitis: transverse and descending colon. Incompetency of ileocæcal valve. Gall-bladder: enlarged. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis. Cholecystitis—calculi. Diverticulitis coli.

Operation: 12-20-18. Incision: T. R. R. Four cm. above navel. Findings: Stomach: slightly enlarged; otherwise normal. Duodenum: apex fixed high and angulated. Gall-bladder: dilated; 4 cm. beyond edge of liver; very tense; containing large calculus at outlet. Cystic duct very small; common duct dilated. Liver: normal. Hepato-duodenal membrane: much thickened and running from proximal half of gall-bladder to duodenum. Pancreas: normal. Cæcum: dilated and thinned. Pericolic membrane: crossing just above cæcum and extending nearly to flexure and compressing ascending colon. Hepatic flexure: free. Appendix: small, atrophic. Diverticulitis: transverse and descending colon and sigmoid. Multiple small fibroids. Procedure: Cholecystectomy: liver bed covered peritoneum, stump of cystic duct buried beneath peritoneum. Mobilization duodenum 6 cm. Mobilization colon. Appendectomy. Closed without drainage. Convalescence: Uneventful except for vomiting the first forty-eight hours.

Result: Some pain, but never severe. Flatulence frequently. Tendency

to constipation; laxative every third night. Appetite very good. Some restrictions of diet. Gained ten pounds and much in strength and endurance. Much improved, three years.

CASE XLI, G. F., F. Thirty-two years. Always had trouble with flatulence and belching of gas, and constipation, but usually no pain. Once a month, usually with her periods, she has a bilious attack, headache, vomiting, etc., lasting one day. Periods regular, three days, profuse, with much pain. Appetite is good. She has always been pale, but more so lately. Always markedly constipated. Dyspnœa on exertion; fatigues easily. In October, 1918 (thirty-two years old), with her bilious attack, she developed sharp pain and tenderness in right iliac fossa. Pain lasted one day, tenderness five days, since when it has diminished but never disappeared.

P. Ex.: She is tall, of large frame, fairly nourished, but quite pale and pasty. Weighs 118 pounds. Heart: normal, except for blowing murmur over left second space. Pulse: 96 (nervous), regular, and of fair quality. Lungs and urine: negative. Abdomen: distended; markedly tympanitic. Stomach: tympany and splashing down to navel and well over to the right side. Marked tenderness at outer border of rectus on line from R. A. S. S. to navel.

X-ray series: Stomach: fish-hook type; lower edge below sacral promontory; peristalsis active; considerable six-hour retention; no sign of ulcer. Duodenum: apex fixed at upper level of lumbar iii in both prone and erect postures. Cap shows no deformity but is small; slight puddling and reverse peristalsis in dependent duodenum. Cæcum and ascending colon: dilated; marked stasis. Hepatic flexure: at iliac crest; shows some narrowing and angulation. Appendix: visualized throughout examination. Ileocaecal valve: incompetent. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 1-15-19. Incision: T. R. R. Two cm. above navel. Findings: Stomach: much enlarged; over in right side, bent back, up and in to duodenum; no ulcer. Duodenum: apex fixed high and kinked sharply. Hepato-duodenal membrane: from cystic duct and proximal gall-bladder (narrow and 3 cm. long) to apex of duodenum. Duodeno-jejunal angle: normal. Pancreas: normal. Gall-bladder: long but normal, except for membrane. Liver: normal. Cæcum: much dilated; thin; pale; adherent to iliac fossa. Appendix: long segmented; irregular; adherent. Pericolic membrane: thick, firm; compressing colon from cæcum about two-thirds of distance to hepatic flexure. Right edge of omentum crossed colon obliquely above cæcum to membrane, and caused deep oblique compression of ascending colon. Hepatic flexure: adhesions between the two limbs, causing sharp angulation. Multiple small fibroids. Ovaries small and cystic. Procedure: Mobilization duodenum; cæcum; colon and hepatic flexure. Appendectomy. Cæcum plicated. Convalescence: Uneventful. On the twenty-first day could eat more food with less discomfort than for years.

Result: Occasional slight pain but in lower abdomen and different from old pain; slight flatulence; slight constipation; laxative twice a week. Appetite very good; can eat everything. Color improved; has great improvement in strength but is not entirely well. Much improved, two years.

CASE XLIII, L. W., F. Thirty-three years. Perfectly well until twenty-two years old, when she began to have attacks of abdominal pain about twice a year, lasting a few days. When twenty-five years old she had a severe attack with nausea and vomiting. Shortly afterward her appendix was removed. Until twenty-eight years old she was free from pain and indigestion, but then began to have attacks of sharp epigastric pain several hours after meals, coming at irregular intervals. Abstention from food caused no change in the pain. It was very likely to follow periods of nervous tension. These pains ceased at thirty years, but were followed by dull aching pain, with much gas distention and tenderness,

especially on the right side. Enemata caused temporary relief. These attacks are associated with no temperature, and rarely with nausea. There is a dragging sensation in epigastrium, relieved by bending forward. Constipation persistent. There is lassitude, memory defect, mental inertia; sleep disturbed by dreams, and unrefreshing. Used to have tonsillitis, but not for several years now. Periods used to be irregular and painful but not since thirty-one years of age. Her weight has not varied. Disability is marked; 60 to 75 per cent.

P. Ex.: She is of medium size, well nourished, of good color. Heart, lungs, urine: negative. Tonsils: small, negative. Abdomen: normal appearance; oblique appendix scar on right side, not very sensitive; very tympanitic all over, but especially over cæcum and up to the level of iliac crest. Pressure over cæcum elicits tenderness, gurgling, fulness, extending up to iliac crest. It also causes shooting pains all over the abdomen. No tenderness above level of iliac crest on right side, nor over gall-bladder. Moderate tenderness in mid-epigastrium and over sigmoid, which was spastic. Kidneys: negative.

X-ray series: Stomach: fish-hook type; lower border at sacral promontory in erect posture; peristalsis hypertonic; empty at three hours. Spot on middle of lesser curvature suspicious of penetrating ulcer, but it caused no defect in peristalsis. Duodenum: apex; prone at level lumbar i; not angulated; cap, normal. Erect at level lower edge lumbar ii, but angulated; cap smaller and elongated. Dependent duodenum shows slight puddling. Ileac stasis: moderate. Cæcum: much dilated; somewhat prolapsed. Ascending colon: dilated below; somewhat narrowed near flexure. Hepatic flexure: close up to duodenum cap; some angulation. Marked retention in cæcum and ascending colon. Ileocæcal valve: incompetent. Gall-bladder: shadow enlarged; no calculi. Pre-operative diagnosis: Hepato-duodeno-colic membrane. Pericolic membrane. Cholecystitis(?). Duodeno-jejunal obstruction(?).

Operation: 1-31-19. Incision: T. R. R. Just above navel. Findings: Stomach: slightly if at all enlarged; no evidence of ulcer on lesser curvature. Duodenum: fixed high, angulated and compressed. No ulcer. Hepato-duodeno-colic membrane: much thickened, starting three cm. back of fundus, running from gall-bladder and cystic duct down to duodenum, across its first portion and on to hepatic flexure. The anterior edge was very thick and rigid and about 0.5 cm. in diameter. It caused marked kinking and compression of duodenum and high fixation and kinking of the flexure. Liver and gall-bladder: normal, except for membrane. Duodeno-jejunal angle and pancreas: normal. Cæcum: much dilated; thin, pale, adherent posteriorly. Pericolic membrane: dense; crossing colon just above cæcum and extending almost to flexure, and causing visible compression. Terminal ileum: normal. Pelvic organs: normal, except that right ovary was fibrotic. Kidneys: normal. Procedure: Mobilization duodenum downward 4 cm. Mobilization colon, cæcum and hepatic flexure. Plication of cæcum. Convalescence: Uneventful.

Result: No pain; slight flatulence; slight constipation; appetite good; eats wide variety. Gained weight; gained enormously in strength and capacity to work both mentally and physically. Much improved, three years. Practically cured.

CASE XLV, H. L. B., M. Forty-eight years. Perfectly well until sixteen years old, when he had sudden pain in left upper abdomen, vomiting and marked constipation. After three days in bed he recovered but has never since felt really well, because of frequent attacks of sour stomach, flatulence, constipation with constant sense of fatigue and lack of rest from sleep. Dieting has prevented the sharp attacks of pain, but he feels wrong in the abdomen all the time. Feels as if an obstruction were in the left upper abdomen. When forty-six he had high blood-uric-acid and high pressure. Under good medical supervision they decreased

to about normal. His constant disturbance disables him considerably. He leads an out-door life.

P. Ex.: He was a large, well-nourished, florid man. Heart, lungs, and urine: normal. Gastric contents: hyperacid. Stools: negative. Abdomen: distended; tympanitic, especially over ascending, transverse colon and stomach. Tenderness is entirely absent. Small umbilical hernia. He points to just beneath tenth left costal cartilage as the area of subjective discomfort, but no objective findings are there.

X-ray series: Stomach: fish-hook type; swings well over to right; lowest part at lumbar v; peristalsis active; empty in four hours. No evidence of ulcer. Duodenum: apex at level upper part lumbar ii, erect, and lower part lumbar i, prone, *i.e.*, marked fixation. Cap is well filled. No ulcer. No puddling in dependent part. Hepatic flexure: fixed and angulated close to duodenal cap. Cæcum and ascending colon: dilated; show stasis after forty-eight hours. Appendix: large, visualized throughout; not tender. Transverse colon: left half showed a marked constriction, spasmodic because of filling later with enema. Ileocæcal valve: incompetent. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 2-20-19. Incision: T. R. R. Two cm. above navel. Findings: Stomach: quite large; pushing well into right flank; otherwise negative. Duodenum: apex fixed high and sharply compressed and kinked; no ulcer. Duodeno-jejunal angle: negative. Appendix: 12 cm. long; dilated; with fibrous cord for tip. Adherent near base. Cæcum: much dilated; filled with semisolid faeces. Pericolic membrane: crossing colon from just above cæcum to about half way to flexure; contained several thickened bands. Hepatic flexure: directly adherent to fundus of gall-bladder by membrane; and to under surface of liver by connective-tissue cord; markedly angulated and constricted. Flexure and ascending colon filled with semisolid faeces. Transverse colon: negative. Splenic flexure unusually high. Hepato-duodeno-colic membrane: holding hepatic flexure to fundus of gall-bladder; passing to lower anterior surface of duodenum; up across its front to the apex which was fixed high and back, and was compressed and angulated. Liver and gall-bladder: negative except for membrane. Procedure: Mobilization duodenum downward 8 cm. Mobilization colon. Appendectomy. Repair umbilical hernia.

Result: Fifth day; died of pneumonia.

CASE XLVI, A. G., F. Thirty-one years. Very well until twenty-two years, when she had keratitis and glaucoma (probably specific). When twenty-seven years, after hard climbing, had severe pain in right upper abdomen; then perfectly well until thirty-one years old, when she had sudden pain in the same place, with much flatulence and constipation. Since then there has always been indigestion, with frequent attacks of distention and constipation. Occasionally vomits very sour stuff half an hour after eating. Constipation very marked. Her periods cause aggravation of digestive troubles. She is very nervous and fatigued. Has lost ten pounds in last four months, and is almost completely disabled.

P. Ex.: She is large, very fat, and ruddy. Mouth, throat, lungs, heart, urine: normal. Pulse 80. Abdomen: wall is fat; tympanitic all over, but most in right upper quadrant; tender all along large gut, but more over cæcum and ascending colon, and most over the flexure and gall-bladder.

X-ray series: Stomach: fish-hook type; dilated; well over in right side. No sign of ulcer. Duodenum: apex at level lower lumbar i, prone, and middle of lumbar ii, erect (marked fixation). Angulated; no sign of ulcer. Hepatic flexure: close up to duodenal cap; angulated; the two limbs in contact for some distance. Cæcum: dilated; diameter fifty per cent. greater than upper ascending

colon, which is somewhat constricted. Pre-operative diagnosis: Hepato-duodenocolic membrane. Pericolic membrane. Chronic appendicitis.

Operation: 2-22-19. Incision: T. R. R. Three cm. above navel. Findings: Stomach: dilated; well over in right side, otherwise negative. Duodenum: apex held high and kinked by an unusually short and rigid gastro-hepatic omentum. Otherwise negative. Liver and gall-bladder: normal; no adhesions and no membrane. Duodeno-jejunal angle: normal. Cæcum: dilated; thin walled. Appendix: much congested; contained concretions. Pericolic membrane: crossing just above cæcum and extending up to hepatic flexure, having thickened bands, above causing kinking and constriction of flexure, and in middle and lower edge causing constriction of ascending colon. Omentum: also attached to upper ascending colon, causing condition seen in picture. Kidneys: normal. Pelvic organs: infantile; left ovary was a cyst 5 to 7 cm. in diameter, freely movable. Procedure: Mobilization duodenum 3 cm. Mobilization cæcum, colon and flexure. Appendectomy. Convalescence: Uneventful.

Result: No pain; occasional flatulence and constipation. Appetite very good; can eat everything. Gained weight and very much in strength. Much improved, two years, ten months. (Almost cured.)

CASE XLVIII, M. V., F. Twenty-five years. Always subject to violent headaches, sometimes associated with bilious attacks, more often not. Always some digestive disturbance, but since twenty-one years old has been definitely distressed in upper abdomen with no definite relation to food. It could frequently be started by playing tennis or any other violent arm exercise. When twenty-four had influenza. Since then extremely tired; has lost weight, but there has been no increased digestive disturbance. Always badly constipated. Has constant sense of discomfort in upper abdomen. Periods irregular, prolonged, profuse, with great pain. Tonsils removed when twenty-three because of frequent sore throat.

P. Ex.: She is tall, thin, pale, pasty and with acne. Mucous membranes are very pale. Teeth: irregular, but healthy. Some remnants of tonsil remaining. Heart, lungs, urine: normal. Pulse 72, fair quality. Abdomen: normal to inspection, markedly tympanitic all over. Tenderness: marked over appendix, over gall-bladder and especially just to the right of mid-epigastrium. This last spot has always been tender and there is present some muscle resistance. Elsewhere no tenderness. Pelvic examination shows cervix eroded from discharge. Uterus: retroflexed, retroverted, not tender, freely movable. No tenderness in either fornix. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis. Displaced uterus.

X-ray series: Stomach: fish-hook type; lower border of greater curvature, prone, at lower lumbar iii; erect, at lower lumbar iv. Duodenum: apex, at level of lower border lumbar i, erect position. At upper border lumbar i, prone. Cap deformed in both positions. No sign of ulcer. Second portion narrowed and flattened. Marked six-hour retention. Cæcum: dilated; shows retention beyond ninety-six hours. Appendix: visualized throughout examination. Ascending colon: constricted near upper end. Hepatic flexure: fixed at level of upper border lumbar iii. Angulated. Transverse colon: prolapsed; runs in contact with ascending colon half way to cæcum. Kidneys and gall-bladder region: negative.

Operation: 4-22-18. Incision: T. R. R. Two cm. above navel. Findings: Stomach: somewhat enlarged, pushed over to right of median line. Duodenum: apex, fixed high, definitely angulated. Pylorus, stomach, duodenum: show no intrinsic disease. Duodeno-jejunal angle: normal. Pancreas: normal. Terminal ileum: normal. Cæcum: dilated. Appendix: adherent; 8 cm. long; angulated; distended. Pericolic membrane: crossed middle of ascending colon from above downward, causing slight constriction but allowing hepatic flexure to fall over

it and cause pressure volvulus. Hepato-duodenal membrane: not present, but gastro-hepatic omentum at right edge quite short and thickened, causing high fixation and distinct angulation of duodenum. Gall-bladder: somewhat large and distended; otherwise normal. Liver: normal. Kidneys: normal. Pelvic organs: Uterus, small, retroverted, retroflexed, freely movable, easily placed in normal position. Procedure: Mobilization duodenum. Mobilization colon. Appendectomy. Convalescence: Uneventful. Made rapid progress; great improvement in color and in strength during hospital stay. Pathological report: Chronic atrophic appendicitis.

Result: No pain; no flatulence; slight constipation; excellent appetite, eats everything; has gained much weight and color and is perfectly well as to general health and capacity for work. Cured, two years, eight months.

CASE L, C. O., F. Twenty-eight years. Perfectly well until twenty-one years of age, at which time, after losing weight and strength without any definite reason, she had a sense of fullness and weight in the epigastrium after eating, also anorexia. She has never been constipated but has a tendency the other way. Similar disturbance came at irregular intervals, and lasted for varying periods. When twenty-eight years old she had an attack in which pain and diarrhoea were added. These attacks became more frequent and persistent and she never felt well any of the time for the last seven months before operation. She lost ten pounds and afternoon temperature frequently reached 100° F. A morning cough now and then has been associated with a little bloody sputum. She is almost completely disabled.

P. Ex.: She is small, thin and pale. Mouth and throat: negative. Sputum: negative. Chest has been repeatedly negative. Pulse: 110, regular, fair quality. Heart: negative. Urine: normal. Abdomen: normal on inspection and percussion. Tenderness: marked over appendix, hepatic flexure and in median line 5 cm. above navel.

X-ray series: Chest shows evidence of tubercular involvement but not extensive. Stomach: marked fish-hook type, much enlarged. Duodenum: Apex at level lumbar i; angulated; cap deformed but not suggestive of ulcer; dependent duodenum slightly distended. Cæcum: dilated; shows marked stasis. Appendix: large, irregular; retains barium forty-eight hours. Ascending colon: much narrowed near hepatic flexure. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 10-25-19. Incision: T. R. R. Just above navel. Findings: Stomach: somewhat enlarged but otherwise normal. Liver and gall-bladder: normal. Duodenum: first portion normal; no membrane to gall-bladder, but a peritoneal fold ran upward from descending duodenum to the under surface of liver well to the right of gall-bladder. Pulling stomach down would develop a kink in duodenum where the fold was attached. Duodeno-jejunal angle: normal. Pericolic membrane: covered upper cæcum and ascending colon to the flexure, causing marked constriction at upper end. Appendix: adherent; angulated; greatly distended. Kidneys: normal. Pelvic organs: normal, except for cyst of left ovary 6 x 4 cm. Procedure: Mobilization duodenum. Mobilization cæcum and colon. Appendectomy. Convalescence: Normal, except for temperature from 100.6 to 101° F., from fifteenth to twenty-third days, for which no reason could be found in urine, chest or wound. Appetite improved; digestion was comfortable and she was feeling well in spite of temperature.

Result: Occasional pain and flatulence; bowels regular; appetite good; eats everything; gained eighteen pounds. General health and endurance greatly increased. Cured, two years, two months.

CASE XXI, C. L. G., F. Twenty-six years. Has always been constipated; no associated headaches, bilious attacks or sour stomach until present illness.

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Periods started at fourteen years, always regular without pain. When twenty-two years old had a cold with fever and nausea, no pain. On getting up felt extreme fatigue, vertigo and pulse was only sixty. Felt sudden griping sensations just above and to the left of navel. During the following year sour stomach, sour eructations have been frequent and getting steadily worse. Constipation has been much aggravated. She has occasional headache, is very irritable. Has cold hands and feet. Pulse even as low as fifty-one. Gets easily exhausted, either by exercise or any excitement. Has only moderate pain and slight flatulence. She is completely disabled.

P. Ex.: She is a woman of medium size, well nourished with high color (excited). Heart, lungs, urine, etc., negative. Abdomen: normal in appearance, tympanitic throughout. Marked tenderness 5 cm. above navel to left of median line. Very slight tenderness in the appendix region. No tenderness over gall-bladder or in mid-epigastrium.

X-ray series: Stomach: fish-hook type; lower border at level of lumbar iv, peristalsis active. No deformity. No sign of ulcer. Large six-hour retention. Duodenum: cap moderately fixed beneath liver, not tender, average size. No sign of ulcer. Duodeno-jejunal angle: fixed at level of lumbar ii with reduction in diameter of terminal duodenum, marked dilation of dependent duodenum. Appendix: not visualized. No evidence of disturbance of cæcum or ascending colon, which were somewhat prolapsed. There was some regurgitation through the ileocolic valve from the enema. Pre-operative diagnosis: Duodeno-jejunal angle obstruction. Hepato-duodenal membrane(?).

Operation: 2-26-18. Incision: T. R. R. Three cm. above navel. Findings: Stomach and pylorus: normal. Duodenum: apex, high and kinked. Gall-bladder: somewhat enlarged, otherwise normal. Hepato-duodenal membrane: running from proximal end of gall-bladder and cystic duct to apex of duodenum. Liver: normal. Duodeno-jejunal angle: pulled upward and to the left by a fold of peritoneum, angulated and turned forward and to right in front of superior mesenteric vessels 2 cm. and there caught by a fold of peritoneum which pulled it strongly upward and to the right. The jejunum then turned sharply downward to the left. There was thus formed a Z-shaped distortion with very marked double angulation, causing very obvious obstruction. Cæcum and ascending colon: appeared normal. No sign of pericolic membrane or of obstruction of the colon. Appendix: very long and narrow, showing no signs of inflammation. Pelvic examination: showed uterus normal, except for one small fibroid in the lower posterior segment. Left tube was hydrosalpinx about 2 cm. in diameter. It was freely movable. Both ovaries: normal. Kidneys: normal. Procedure: Mobilization of duodenum. Mobilization of duodeno-jejunal angle (plastic). Appendectomy. Convalescence: Uneventful.

Result: Three years, ten months. No pain; slight flatulence. Appetite good, eats everything. Has gained only three pounds in weight, but has entirely regained vigor and endurance. Much improved, three years, ten months. (Practically cured.)

CASE XXXI, J. W., F. Seventeen years. Perfectly well until three years old, when typhoid fever developed. After that had bronchitis, la grippe, chicken-pox. Ever since that time she has had much digestive disturbance, anorexia, constipation, loss of weight, flatulence, discomfort after small amounts of food, severe headaches and great nervous depression with loss of stamina. When sixteen and one-half years old she had bad bronchitis, followed by mumps; later had measles and many attacks of epistaxis. After meals she has frequency of micturition with some burning, almost no endurance; pain usually comes definitely two hours after eating, is eased by lying down. Hands and feet are always

clammy, and she is almost completely disabled. Her periods are regular at five weeks, profuse and with much pain. Bed-ridden at this time.

P. Ex.: Tall, thin, fairly nourished, but has fair color. Pulse 72, good quality. Heart, lungs, urine, stool: negative. Hæmoglobin, 81 per cent.; red blood-cells, 4,740,000. Abdomen: retracted, showing but little flatulence. Stomach: percusses to median line and down to navel. Sigmoid: spastic and tender. Marked tenderness and resistance 3 cm. above navel, just to the left of mid-line. Marked tenderness below right rectus just above level of R. A. S. S. No tenderness over gall-bladder, nor in mid-epigastrium.

X-ray series: Stomach: marked fish-hook type. Greater curvature in true pelvis. Peristalsis: active. No indication of ulcer. Six-hour retention. Duodenum: apex, level of lumbar iv. Cap normal; no sign of ulcer. Descending limb and dependent duodenum filled easily; dilated markedly, showing reversed peristalsis and writhing, and tenderness over the angle. Some stasis in cæcum and ascending colon. At forty-eight hours entire colon was still visualized. Appendix was visualized throughout examination. Hepatic flexure: quite movable; sometimes below, sometimes above iliac crest. Ileocæcal regurgitation. Pre-operative diagnosis: Duodeno-jejunal angle obstruction. Chronic appendicitis.

Operation: 5-30-18. Incision: T. R. R. Just above navel. Findings: Stomach and duodenum: normal. Gall-bladder: normal. Duodeno-jejunal angle: showed firm, strong band running upward and to the left, pulling the angle well out and up, causing sharp angulation and constriction by membrane pressing in front of angle. When this band was divided the angle came downward and the duodenal contents very promptly passed the obstruction. There was no evidence of obstruction by mesenteric vessels. Beneath the peritoneum about the mesenteric vessels were several enlarged lymph-glands of which one was removed for examination. The overlying peritoneum was also somewhat thickened. Terminal ileum: negative. Cæcum: was located on a level with the crest of the ilium. It was somewhat dilated. Pericolic membrane: Broad and thick, covered the entire cæcum, ascending colon, hepatic flexure and beginning transverse colon. It caused general compression and some angulation. It showed two thickened bands passing across the mid-portion of ascending colon. There was also a band running from beginning transverse colon up to pyloric antrum of stomach, holding the two firmly in close contact. Appendix: 10 cm. long, rather small calibre, irregular with fairly long mesentery. Beneath the peritoneum in the ileocæcal angle were many lymphatic glands, of which one was removed for examination. Pelvic organs: normal, except for ovoid cyst at fimbriated end of right tube. Kidneys: normal. Spinal column came unusually far forward. Procedure: Mobilization duodeno-jejunal angle. Mobilization cæcum, ascending and transverse colons. Appendectomy. Lymphadenectomy. Removal fimbriated cyst. Pathological report: Calcified lymph-node. Chronic appendicitis. Convalescence: Uneventful.

Result: Three years, seven months. Improved. No pain; some flatulence; some constipation; fair appetite, eats everything. No gain in weight. Improvement in general health and strength. Still troubled with lassitude. Improved, three years, seven months.

CASE XXXVI, C. H., F. Forty-five years. As a child had "inflammation of the bowels" for a few weeks. Ever after there was such digestive disturbance that she was not expected to live. She has always had considerable digestive disturbance. When forty-one digestion became very much worse and ever since has given increasing trouble. Attacks are characterized by sudden excess of flatulence, distention and severe pain, often with nausea and vomiting, and great loss of strength; marked constipation, but as far as she knows there has been no fever. About four months before operation, during an attack, the appendix

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region was extremely tender to pressure. Since forty-two years of age there have never been any normal movements and the taking of medicine has caused temporary diarrhoea, so there has been serious trouble in the regulation of the bowels.

P. Ex.: She is tall, fairly well nourished, but dragged out, pasty and pale in appearance. She is extremely nervous. Teeth: in bad condition; much pyorrhœa. Tonsils: show infection. Heart, lungs, urine: negative. Abdomen: normal to inspection. Markedly tympanitic everywhere. Moderate tenderness over the appendix region, to less extent over the cæcum. No tenderness over hepatic flexure, gall-bladder, or in the epigastrium.

X-ray series: Not taken for reasons. Pre-operative diagnosis: Pericolic membrane. Chronic appendicitis.

Operation: 6-19-18. Incision: T. R. R. Two and five-tenths cm. above navel. Findings: Stomach: considerably enlarged and pushed over to right side, otherwise normal. Duodenum: normal; no fixation. Gall-bladder and liver: normal. Duodeno-jejunal angle: normal. Cæcum: very greatly distended, thin and pale. Appendix: 12 cm. long, 1 cm. in diameter. Kidneys: normal. Pericolic membrane: dense, thick, upper edge being much thickened, holding hepatic flexure high, causing angulation and very marked constriction. The lower edge was also thickened and crossed ascending colon slightly below its middle. Pelvic organs: normal. Procedure: Mobilization colon. Appendectomy. Plication of cæcum. Convalescence: Uneventful.

Result: Two years, four months. Improved. Some pain and flatulence. Occasional constipation. Appetite good, eats everything. Color and general endurance greatly improved. (Still has infected teeth and tonsils.) Improved, two years, four months.

CASE XXVI, D. C., F. Twenty-six years. Usually pretty well, always marked constipation since childhood. Periods began at fourteen, always perfectly regular, painless. Always extremely nervous. When twenty-two years old had an attack of "appendicitis," also two when twenty-three years old and one when twenty-four. During the time between twenty-three years and twenty-four years old there were a number of attacks of abdominal pain associated with inability to flex the right hip. When twenty-four constipation became worse than ever and there was much pain, flatulence, marked lassitude, headache and general discomfort. Restrictions in diet caused marked improvement. In November, 1916, twenty-four years old, there was an attack of pain and tenderness over the appendix, but without vomiting or fever. Every few months since there have been similar attacks. They are becoming more frequent until now the interval is only ten to fourteen days. With the final attack at twenty-six years of age, for the first time there was vomiting and definite localized tenderness. There was no fever and no increased leucocytosis. Her general health and endurance have depreciated so that she is practically completely disabled.

P. Ex.: She is tall, well formed, fairly nourished, pale, extremely nervous. Heart, lungs, urine, gastric contents: negative. Pulse 80, of fair quality. Abdomen: anterior wall slightly retracted; moderately tympanitic everywhere. Tenderness over sigmoid, which was slightly spastic. No tenderness in epigastrium, over gall-bladder or over ascending colon. Cæcum: felt to be somewhat thickened and distended and tender. Sharply circumscribed tenderness over appendix region.

X-ray series: Omitted. Pre-operative diagnosis: Chronic appendicitis. Pericolic membrane(?).

Operation: 5-11-18. Incision: Intermuscular; right side, Weir modification. Findings: Transverse colon: markedly prolapsed. Cæcum: adherent to iliac fossa, fixed by definite pericolic membrane. Appendix: small, fibrous, distended

near tip. Covered also by extension of pericolic membrane. Pericolic membrane: covering appendix, cæcum and ascending colon where there was a firm, thick fold which caused definite compression and distortion. Another band ran obliquely downward across the hepatic flexure, causing angulation. Gall-bladder: normal in appearance and feeling. No hepato-duodenal membrane could be made out. Pylorus and duodenum passed under fundus of gall-bladder. Pelvic organs: normal. Procedure: Mobilization of cæcum and colon. Appendectomy. Convalescence: Uneventful.

Result: One year, eight months, much improved. Some pain and flatulence. No constipation. Appetite good. Gained thirty pounds in weight and improved much in general strength. Much improved, one year, eight months.

CASE XXXVIII, J. T. S., M. Forty-six years. For fifteen years has had marked digestive disturbances. Was treated at various times for hyperacidity, ulcer, etc. Troubles are getting worse with occasional improvement. Chief difficulty is pain and distress after food; heart-burn, sense of heaviness and discomfort, profound fatigue and headaches. There has been some loss of weight. Very marked disability. There is always mental inertia, some confusion and little capacity for brain work. Constipation is usually present. Marked flatulence. There is dull pain at level of navel which is not influenced by food. On the whole, his troubles are becoming worse rather than better.

P. Ex.: He is a tall, well-developed man; thin, sallow looking and with the appearance of constant suffering. Pyorrhœa and foul breath are obvious. Heart, lungs, urine, stool: negative. Abdomen: somewhat prominent, although there is no fat. It is markedly tympanitic everywhere. Stomach: enlarged down to umbilicus and over into the right side. Splashing is readily obtained at any time. Sigmoid: spastic and moderately tender. Moderate tenderness over appendix region. Otherwise examination was negative. Gastric analysis shows nothing of interest except hypersecretion and hypermotility.

X-ray series: Stomach: fish-hook type; within average size. peristaltic waves quite active; occasional pylorospasm, no sign of ulcer. Duodenum: Cap filled promptly; normal in size and appearance. No indication of ulcer. It is fixed and somewhat angulated. Dependent duodenum: Showed some dilation, marked reverse peristalsis with writhing, twisting, very suggestive of obstruction at the duodeno-jejunal angle. Remainder of series not permitted. Pre-operative diagnosis: Obstruction at duodeno-jejunal angle. Chronic appendicitis(?).

Operation: 6-16-18. Incision: T. R. R. Just above navel. Findings: Stomach: enlarged; pushed over to right side. Hepato-duodenal membrane: ran from proximal gall-bladder and cystic duct to front of first portion of duodenum, causing fixation and angulation at apex of moderate degree. Duodeno-jejunal angle: shows fold of peritoneum running upward and to the left, causing elongation and definite kinking, also compression where the membrane crossed in front of the angle. There seemed to be no other disturbance in the neighborhood. Ileum: negative. Pericolic membrane: covered the whole length of cæcum and ascending colon, causing moderate compression. Upper edge showed firm, large band, causing marked angulation and compression of the hepatic flexure. There were also strong adhesions between ascending and transverse colons about 10 cm. from hepatic flexure. It aggravated the angulation of the hepatic flexure. Appendix: small; quite congested and bulbous near tip. Liver, gall-bladder, pancreas, kidneys: normal. No sign of ulcer in either the stomach or duodenum. Procedure: Mobilization duodenum. Mobilization colon. Mobilization duodeno-jejunal angle (plastic instead of anastomosis). Appendectomy. Convalescence: Uncomfortable. Extremely restless and nervous, asking for narcotics. Discharge from the wound on tenth day, healing completed on the twenty-eighth day.

Result: Three years, six months, improved. Seldom has pain, no constipation. Appetite good, no limitation of diet. Endurance is definitely increased, but still troubled with lassitude. Improved, three years, six months.

CASE XLII, D. C., F. Twenty-two years. In good health until seventeen years old, but has always had occasional attacks of lower abdominal pain after over-eating. When seventeen definite attacks of pain occurred every few months; sharp, cramp-like in character, lasting from a few minutes to two hours; rarely associated with nausea, almost never with temperature. These attacks have been getting more frequent, more definite, more persistent. During the last six months she has been confined to bed for a few days with each of three separate attacks which were associated with nausea, vomiting and a temperature of 101.5. During the last six months she has been weak, very nervous, sleepless and almost completely disabled. There is marked flatulence; bowels have always had a tendency to be loose. Periods have always been normal. She has lost much in color; appetite is poor. Physician states she had tuberculous lesion of left upper lobe, which is now healed.

P. Ex.: She is tall, medium weight, well nourished, slightly pale. Lung shows healed lesion. Heart: normal. Rather nervous and irritable. Abdomen: normal in contour, tympanitic everywhere. Distinct tenderness over the appendix region. Slight tenderness over the gall-bladder; marked tenderness in mid-epigastrium. Urine and stools: negative.

X-ray series: Stomach: average size, fish-hook type, no sign of ulcer. Peristalsis: normal. Empty in three hours. Duodenum: apex; standing, at level of lumbar ii; prone, dorsal xii, shows distinct angulation. Cap, small, no deformity suggestive of ulcer. Dependent duodenum: slightly enlarged, no sign of obstruction. Cæcum and beginning ascending colon: markedly dilated. Upper ascending colon and hepatic flexure: high, narrow, sharply angulated. Transverse colon: apparently closely attached to upper ascending colon. Appendix: visualized throughout. Some regurgitation through the ileocæcal valve. Pre-operative diagnosis: Hepato-duodenal membrane. Pericolic membrane. Chronic appendicitis.

Operation: 1-16-19. Incision: T. R. R. Two cm. above navel. Findings: Stomach: appeared normal, no sign of ulcer. Duodenum: fixed high and kinked. Hepato-duodeno-colic membrane: ran from middle of gall-bladder to cystic duct, downward to first portion of duodenum onward to hepatic flexure, which was held high and angulated. Liver and gall-bladder: normal, except for membrane. Duodeno-jejunal angle: showed slight kinking by membrane running across its front and upward to the left. Cæcum and appendix: quite adherent to iliac fossa. Appendix: short, kinked, segmented with bulbous tip. Pericolic membrane: very thick; covered ascending colon from just above the cæcum nearly to hepatic flexure. This caused marked compression of ascending colon, especially at the upper end. Pancreas, kidneys: normal. Pelvic organs: normal, except for right ovary, which was somewhat enlarged, firm and prolapsed. Pathological report: Chronic appendicitis. Procedure: Mobilization duodenum, 5 cm. Mobilization colon. Mobilization duodeno-jejunal angle. Appendectomy. Convalescence: Uneventful, except for extreme nervousness and hysterical outbursts.

Results: After six months has gained fifteen pounds, feeling very well in every way. No pain except following over-eating. Is sometimes troubled with diarrhœa. Very little flatulence. Appetite good, can take almost any food. Has not regained her strength. About one year later she developed tuberculosis definitely and has since been at a sanatorium. Her digestive symptoms were, therefore, much improved during the early part of her post-operative period, but her later troubles have destroyed the value of the operation. Digestive result, after six months. Much improved.

CASE XLIX, N. M. A., F. Thirty-six years. For eleven years she has had a great deal of trouble with constipation and some hemorrhoids. By careful attention to diet she got along fairly well. When thirty-three years old she had measles and was quite sick. This attack was followed by digestive disturbances, so that six months later her appendix was removed. When thirty-four years old she began having troublesome pains in the upper abdomen and left chest. No heart trouble could be found, but palpitation was constantly present when her pain was troublesome. Within a few months of the onset of these pains she had a complete breakdown. She has made some improvement, but is still distinctly neurasthenic. Trouble is getting to be more disturbing as time goes on. Bowels are markedly constipated. Now and then she has bleeding from the hemorrhoids and an occasional fissure forms. She has lost a few pounds in weight. From thirty-five on flatulence and abdominal pains have increased very much in frequency and severity and are now aggravated, especially in the right lower quadrant.

P. Ex.: She is of a small size, slender and quite pale. She has the appearance of prolonged suffering. She is almost completely disabled. Heart, lungs, urine: normal. Abdomen: normal in appearance. Shows appendix scar. There is tympany everywhere but it is most marked in the right lower quadrant, running upward toward the hepatic flexure. Cæcum and ascending colon: distinctly dilated, distended and are definitely tender. Moderate tenderness in the mid-epigastrium. Pelvic examination: shows ovarian tumor about 9 x 6 cm. Otherwise pelvic organs seem normal.

X-ray series: Stomach: marked fish-hook type. No sign of ulcer. Lowest border of stomach within true pelvis; marked six-hour retention. Duodenum: apex, lower border lumbar iii, erect; middle lumbar ii, prone. Sharp angulation; cap moderately filled; no sign of ulcer. Descending duodenum: at first narrow, then showing marked puddling of dependent portion. Six-hour retention in duodenum. Hepatic flexure: fixed at level of lumbar ii, showing angulation. Cæcum and beginning ascending colon: dilated. Pre-operative diagnosis: Hepato-duodenal membrane. Duodeno-jejunal angle obstruction. Pericolic membrane. Post-operative adhesion. Ovarian tumor.

Operation: 6-14-19. Incision: Vertical left rectus, below navel. Removal cystic tumor, left ovary, wound sutured. Incision: T. R. R. Three cm. above navel. Findings: Stomach: enlarged, pushed over to left. Duodenum: apex, fixed high and kinked. Hepato-duodenal membrane: from proximal gall-bladder and cystic duct to apex of duodenum. Duodeno-jejunal angle: definitely obstructed. Dependent duodenum: much dilated; 4.5 cm. in diameter. Broad adhesions to old appendix scar. Right edge of omentum crossing lower ascending colon, causing marked constriction. Pericolic membrane: across middle of ascending colon, causing constriction. Pancreas, gall-bladder, kidneys: normal. Pelvic organs: normal except for left cyst. Procedure: Mobilization duodenum downward 3 cm. Mobilization colon. Duodeno-jejunostomy. Separation of adhesions. Convalescence: Uneventful.

Result: Two years. Improved. Still has some pain and flatulence and slight constipation. Color and nutrition improved. Appetite good. General endurance not greatly improved. Improved, two years.

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EPITHELIOMA OF THE GENITO-URINARY ORGANS*

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MALIGNANT neoplasms of the genito-urinary organs that arise from protective epithelium vary from soft, frond-shaped papillary epitheliomas of the bladder and of the pelvis of the kidney to ulcerated and indurated keratinized epitheliomas of the vulva and of the penis.

The term cancer is used loosely, but it is very important to know the type of cancer in a given case. No one would think of putting the ordinary garter snake and the death-dealing cobra in the same class, but they are both snakes. No one would think of putting the basal-cell epithelioma and the highly malignant melanotic epithelioma in the same class, but they are both cancers. A neoplasm can accomplish only what its cells can accomplish; if its cells are active, it is active. A neoplasm may be of papillary form and of a low degree of malignancy, or it may be papillary and of a high degree of malignancy. It may be flat or ulcerated and of a high degree of malignancy, or it may be flat or ulcerated and of a low degree of malignancy.

In two previous articles on epithelioma I divided the lesions, from the standpoint of cellular activity, into four groups. In grading epitheliomas one must always take into consideration the normal epithelium of the organ from which the epithelioma has arisen. The epithelium of the bladder, while of the protective type, differs from that of the lip and skin in that it lacks a well-defined keratinized or horny layer. Irritation in the bladder from a stone will produce an area of keratinization or leucoplakia for protective purposes just as the constant handling of an ax or shovel will produce areas of excessive keratinization on the palms of the hands in the form of calluses. Keratinization is a physiologic and not a pathologic process; without this process we would not have hair, finger nails, and toe nails, and animals would not have hoofs and horns. The normal cervix has some keratinization, while a prolapsed uterus may have a rather marked keratinization of its cervix epidermis. The penis and labium have about the same amount of keratinization normally as the lip and skin.

Papillary epitheliomas of the bladder, microscopically, often resemble the normal folds of bladder epithelium. Often they are composed of slender cells which resemble those of the basal layer; they also contain polyhedral cells resembling those of the upper layer. The grading of epitheliomas of the bladder depends on the proportion of these cells in the neoplasm com-

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pared with the spherical cells and irregular cells with prominent nucleoli (undifferentiated cells). Papillary epitheliomas of the pelvis, of the kidney and ureter are similar in structure.

Epitheliomas of the cervix, vagina, labium, and penis can be graded on the basis of the proportion of keratinization and large flat squamous cells with small nuclei to the number of undifferentiated cells. Microscopically, some epitheliomas of the cervix and vagina resemble the basal-cell epitheliomas of the skin; however, they should not be considered in the same group because they are highly malignant, and behave very much like the same type of epitheliomas of the tonsil and nasopharynx.

Grades of Epitheliomas.—I shall use the same grading of epitheliomas in this series of cases that I used in my two previous papers on epithelioma; that is, if about three-fourths of the epitheliomas are differentiated epithelium and one-fourth undifferentiated, they are graded 1 (Figs. 1, 2, and 3); if the differentiated and undifferentiated epithelium are about equal they are graded 2 (Figs. 4, 5, and 6); if the undifferentiated epithelium forms about three-fourths and the differentiated about one-fourth of the growth they are graded 3 (Figs. 7, 8, and 9); and if there is no tendency to cell differentiation they are graded 4 (Figs. 10, 11, and 12). The number of mitotic figures and the number of cells with single, large, deeply staining nucleoli play an important part in the grading.

My primary object in presenting this paper is to furnish data that will have a practical bearing on prognosis. From this standpoint, the size and location of the epithelioma are extremely important. An epithelioma may be relatively small and of an average degree of malignancy, but its location may make its complete extirpation, with the regional lymph-nodes, almost impossible.

Exact dimensions of the lesion were obtained in most cases, but it was impossible to obtain them in all, especially if a cautery had been used; in these only approximate sizes were secured, which were divided, from the surgeon's description, into small, medium, and large. The lesions in which the exact dimensions were obtained were also divided into three groups. If the greatest diameter of the lesion was 2 cm. or less it was considered small; if it was from 2 cm. to 4 cm. it was considered medium, and if it was more than 4 cm. it was considered large. Thus, a combination of exact and approximate dimensions of practically all lesions were secured.

Metastasis was considered only when the lesion was in the labium or penis; it was not possible to obtain all the regional lymph-nodes in the other cases. Even in the cases of lesions in the labium or penis it was not possible to obtain all the regional lymph-nodes because some of the lymphatics from these organs drain into the pelvis. In cases of lesions of other organs, especially the cervix and vagina, often only a small portion of the growth was obtained for examination, the remainder having been treated with the actual or the Percy cautery. In cases of lesions of the bladder, lymph-nodes were obtained only occasionally.

CONCLUSIONS

1. The 473 cases in this series represent 23.65 per cent. of 2000 cases of general epithelioma observed in the Mayo Clinic from November 1, 1904, to July 22, 1915.

2. Epithelioma of the genito-urinary organs occurred more often in females than in males; the proportion was about three to one.

3. The average age of all patients was 50.04 years. The average age of patients with lesions of the cervix was 47.25 years, of the bladder 53.51 years, of the labium 57.87 years, of the penis 54.1 years, of the vagina 46.72 years, and of the urethra 57.75 years.

4. Ninety-five and ninety-eight hundredths per cent. of all patients were married or had been married; 98.53 per cent. of the patients with lesions of the cervix were married or had been married; 93.53 per cent. of the patients with lesions of the labium were married or had been married; 93.08 per cent. of the patients with lesions of the penis were married or had been married; and 100 per cent. of the patients with lesions of the vagina were married or had been married.

5. Thirty-three and eighty-five hundredths per cent. of the men were farmers, in contrast to 56.7 per cent. of farmers among the patients with squamous-cell epithelioma of the lip, and 53.96 per cent. among patients with squamous-cell epithelioma of the skin.

6. Eleven and eighty-three hundredths per cent. of the patients had a family history of malignancy.

7. Eighty-nine and thirty-four hundredths per cent. of the patients with lesions of the cervix, 88.88 per cent. with lesions of the labium, and 94.10 per cent. with lesions of the vagina had been pregnant one or more times.

8. Forty-one and twenty-six hundredths per cent. of the patients with lesions of the cervix had passed the menopause.

9. Ninety-three and sixty-three hundredths per cent. of the patients with lesions of the cervix, 94.17 per cent. with lesions of the bladder, 88.88 per cent. with lesions of the vagina, and 75 per cent. with lesions of the urethra gave histories of hemorrhage.

10. The average duration of the lesion in the cervix was 0.79 year, in the bladder 2.60 years, in the labium 1.73 years, in the penis 1.44 years, in the vagina 0.69 year, and in the urethra 0.87 year.

11. The average duration of the lesion in all of the patients was 1.35 years.

12. Sixty-six and thirty-nine hundredths per cent. of the lesions of the cervix, 40.50 per cent. of the bladder, 18.18 per cent. of the labium, 22.73 per cent. of the penis, and 71.42 per cent. of the vagina were large.

13. Twenty-seven and twelve hundredths per cent. of the lesions of the cervix, 51.89 per cent. of the bladder, 50.09 per cent. of the labium, 54.54 per cent. of the penis, and 28.57 per cent. of the vagina were medium.



FIG. 1.—(A125824). Grade I epithelioma of the penis.

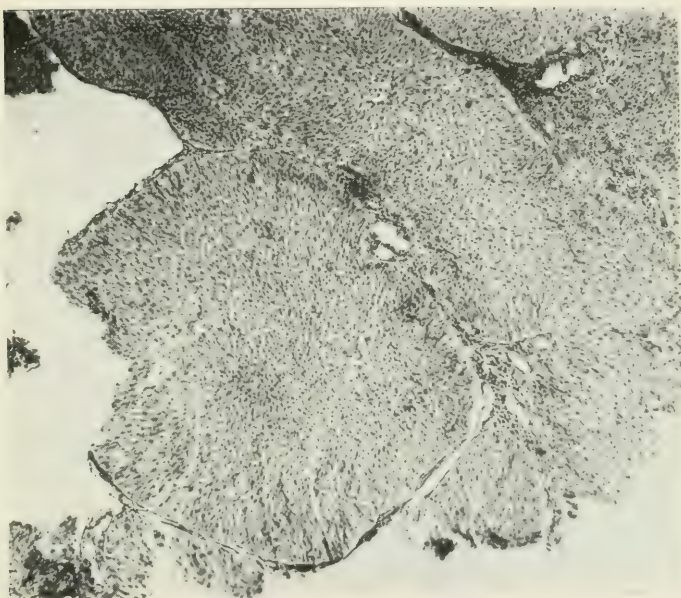


FIG. 2.—(A83994). Grade I epithelioma of the bladder.



FIG. 3.—(A23702). Grade I epithelioma of the bladder.



FIG. 4.—(A72771). Grade 2 epithelioma of the cervix.

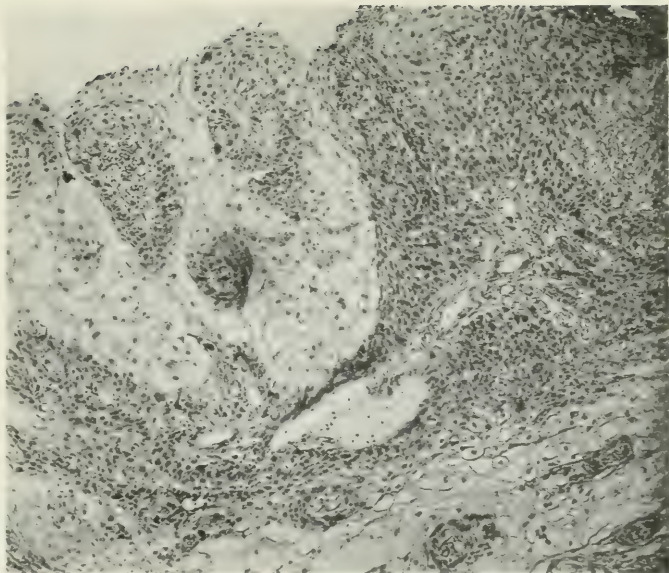


FIG. 5.—(A 27862). Grade 2 epithelioma of the bladder.

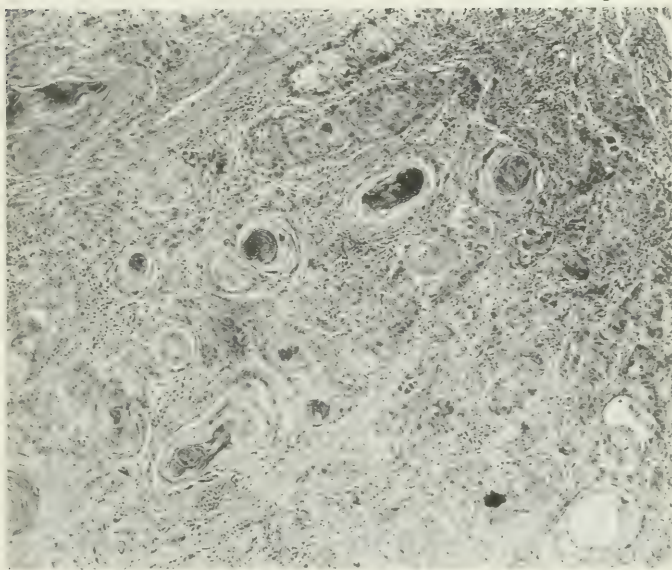


FIG. 6.—(A115009). Grade 2 epithelioma of the penis.

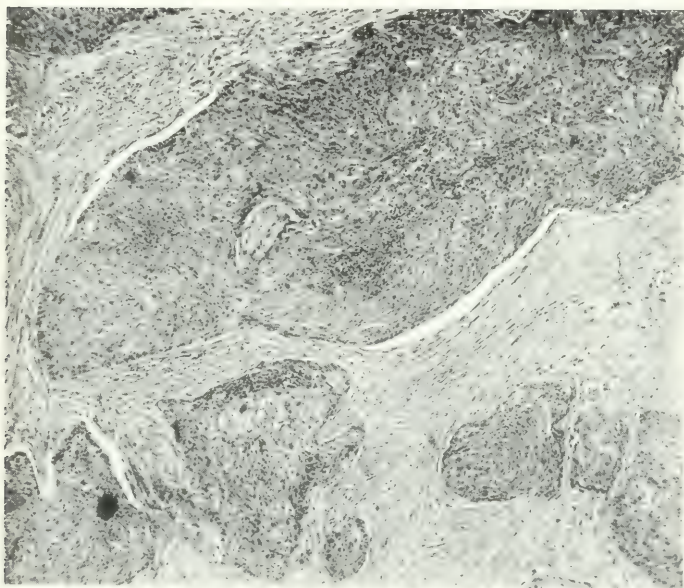


FIG. 7.—(A43008). Grade 3 epithelioma of the cervix.

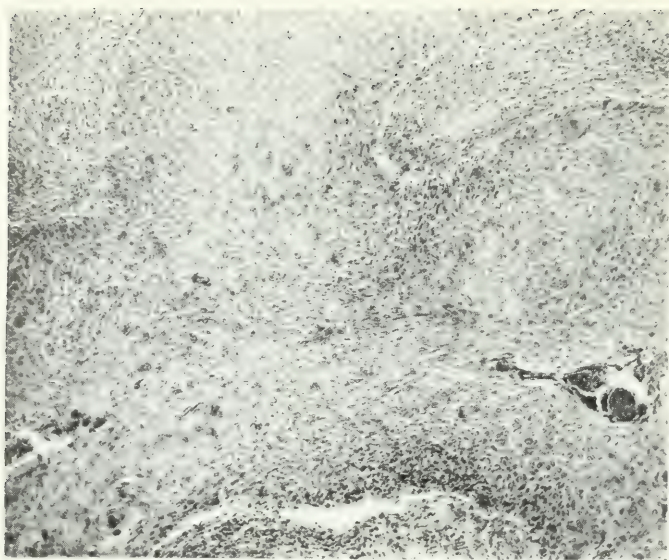


FIG. 8.—(A90468). Grade 3 epithelioma of the cervix.

EPITHELIOMA OF THE GENITO-URINARY ORGANS

14. Six and forty-seven hundredths per cent. of the lesions of the cervix, 7.59 per cent. of the bladder, 22.73 per cent. of the labium, and 22.73 per cent. of the penis were small.

15. Fifty-six and eighty-seven hundredths per cent. of the epitheliomas of the genito-urinary organs were located in the cervix, 25.36 per cent. in the bladder, 6.55 per cent. on the labia, 6.13 per cent. on the penis, 3.80 per cent. in the vagina, 0.84 per cent. in the urethra, 0.21 per cent. in the pelvis of the kidney, and 0.21 per cent. in the ovary.

16. Ninety-three and two hundredths per cent. of all patients were operated on.

17. In 62.96 per cent. of the operable cases of lesions of the labium the inguinal lymph-nodes were removed; metastasis was demonstrated in 58.82 per cent.

18. In 78.57 per cent. of operable lesions of the penis the inguinal lymph-nodes were removed; metastasis was demonstrated in 18.18 per cent.

19. In a classification of the epitheliomas of all of the genito-urinary organs according to cellular activity, 5.07 per cent. were graded 1, 24.52 per cent. were graded 2, 43.55 per cent. were graded 3, and 26.84 per cent. were graded 4.

20. Seventy-six and fifty-nine hundredths per cent. of the patients operated on have been traced; 21.36 per cent. are living, 78.63 per cent. are dead.

21. Ninety-four and forty-four hundredths per cent. of the living patients report good results; they have lived on an average of 8.58 years since the last or only operation.

22. Excluding postoperative deaths and deaths in which the cause was not determined, 6.72 per cent. of the patients obtained good results and lived on an average of 6.34 years after the last or only operation.

23. Excluding postoperative deaths and deaths in which the cause was not determined, 93.27 per cent. of deaths were caused by epithelioma; these patients lived on an average of 1.34 years after the last or only operation.

24. Twenty and seventy-two hundredths per cent. of patients with lesions of the cervix, who had been pregnant, obtained good results, and 79.26 per cent. obtained poor results, contrasted with good results in 12.50 per cent. and poor results in 87.50 per cent. in those who had not been pregnant.

25. Ten and nine hundredths per cent. of the patients with large lesions of the cervix obtained good results, and 89.90 per cent. obtained poor results. Thirty-three and thirty-three hundredths per cent. of patients with medium lesions obtained good results, and 66.66 per cent. obtained poor results. One hundred per cent. of patients with small lesions obtained good results.

26. Thirty-three and thirty-three hundredths per cent. of patients with large lesions of the bladder obtained good results, and 66.66 per cent. obtained poor results. Forty-six and sixty-six hundredths per cent. of patients with

medium lesions of the bladder obtained good results, and 53.33 per cent. poor results. Eighty per cent. of the patients with small lesions of the bladder obtained good results and 20 per cent. obtained poor results.

27. Nine and nine hundredths per cent. of the patients with medium lesions of the labium obtained good results, and 90.90 per cent. poor results. Twenty-five per cent. of the patients with small lesions obtained good results, 25 per cent. fair results, and 50 per cent. poor results.

28. One hundred per cent. of the patients with large lesions in the penis obtained poor results; 37.50 per cent. of the patients with medium lesions obtained good results, 12.50 per cent. fair results, and 50 per cent. poor results; 66.66 per cent. of the patients with small lesions obtained good results, and 33.33 per cent. poor results.

29. One hundred per cent. of the patients with large lesions in the vagina obtained poor results, and 100 per cent. of the patients with medium lesions obtained good results.

30. Fourteen and twenty-eight hundredths per cent. of the patients with metastasis who had lesions in the labium obtained good results, and 85.71 per cent. poor results; 20 per cent. of the patients without metastasis obtained good results, 20 per cent. fair results, and 60 per cent. poor results; 20 per cent. of the patients in whom no regional lymph-nodes were removed obtained good results, and 80 per cent. poor results.

31. One hundred per cent. of the patients with metastasis who had lesions in the penis obtained poor results, 63.63 per cent. of the patients without metastasis obtained good results, 9.09 per cent. fair results, 27.27 per cent. poor results, and 100 per cent. of the patients in whom no regional lymph-nodes were removed obtained poor results.

32. Seventeen and seventy-seven hundredths per cent. of the patients with lesions of the cervix are alive with good results, they have been free from the disease for an average of 9.32 years.

33. Two and twenty-two hundredths per cent. of the patients with lesions of the cervix obtained good results, and had been free from disease an average of 6.05 years at the time of death.

34. Twenty per cent., or one in five, patients with lesions of the cervix obtained good results.

35. Eighty per cent. of the patients with lesions of the cervix obtained poor results, and lived an average of 1.27 years.

36. Thirty-seven and fourteen hundredths per cent. of the patients with lesions of the bladder are alive with good results; they have been free from the disease for an average of 7.54 years.

37. Eleven and forty-two hundredths per cent. of the patients with lesions of the bladder obtained good results, and had been free from the disease an average of 6.26 years at the time of death.

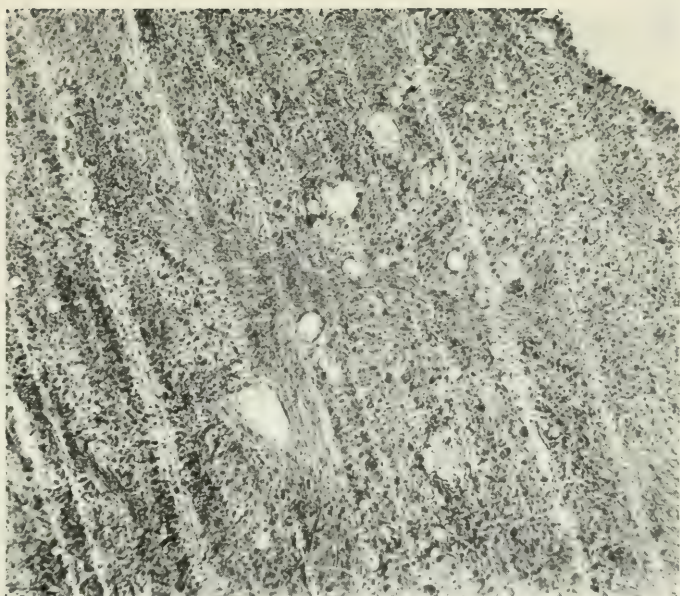


FIG. 9.—(A30633). Grade 3 epithelioma of the bladder.



FIG. 10.—(A89680). Grade 4 epithelioma of the cervix.

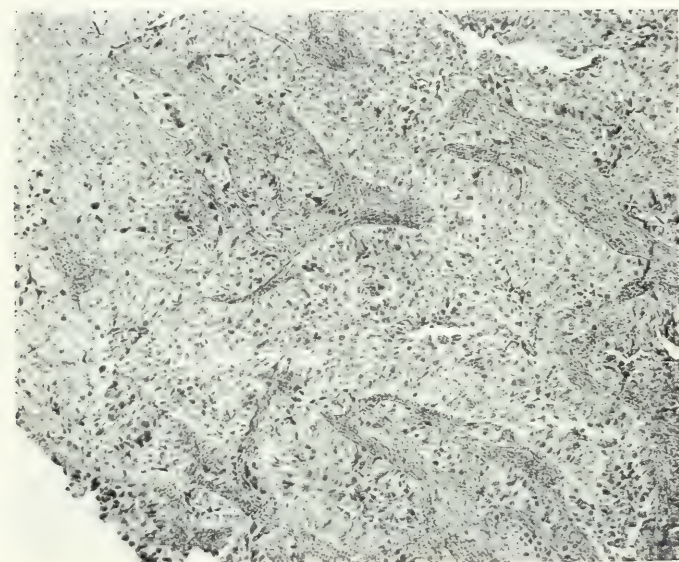


FIG. 11.—(A61721). Grade 4 epithelioma of the bladder.

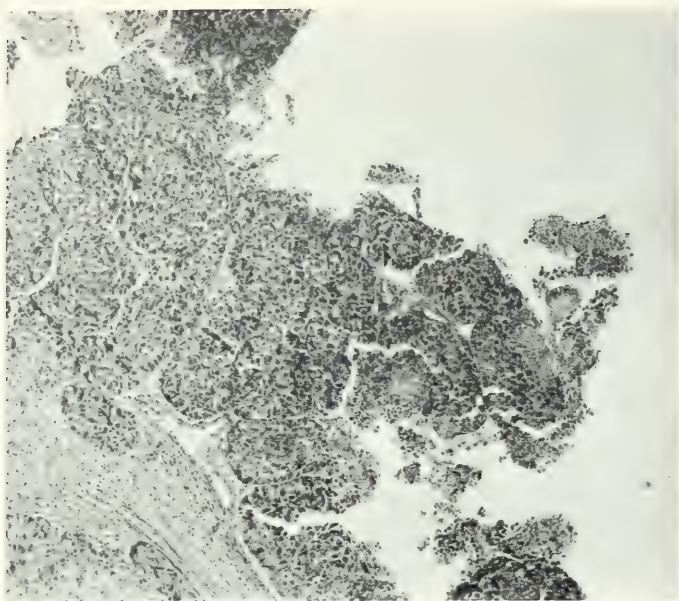


FIG. 12.—(A63803). Grade 4 epithelioma of the bladder.

EPITHELIOMA OF THE GENITO-URINARY ORGANS

38. Forty-eight and fifty-six hundredths per cent., nearly one-half of the patients, with lesions of the bladder obtained good results.

39. Two and eighty-five hundredths per cent. of the patients with lesions of the bladder are alive with fair results.

40. Forty-eight and fifty-seven hundredths per cent. of the patients with lesions of the bladder obtained poor results; they lived for an average of 1.22 years.

41. Seventeen and sixty-four hundredths per cent. of the patients with lesions of the labium are alive with good results; they have been free from the disease for an average of 7.78 years.

42. Five and eighty-eight hundredths per cent. of the patients with lesions of the labium obtained fair results.

43. Seventy-six and forty-seven hundredths per cent. of the patients with lesions of the labium obtained poor results; they lived an average of 2.47 years.

44. Twenty-three and fifty-two hundredths per cent. of the patients with lesions of the penis are alive with good results; they have been free from the disease for an average of 10.42 years.

45. Seventeen and sixty-four hundredths per cent. of the patients with lesions of the penis who are dead obtained good results and had been free from the disease an average of 6.95 years.

46. Forty-one and sixteen hundredths per cent. of the patients with lesions of the penis obtained good results.

47. Five and eighty-eight hundredths per cent. of the patients with lesions of the penis obtained fair results.

48. Fifty-two and ninety-four hundredths per cent. of the patients with lesions of the penis who are dead obtained poor results; they lived for an average of 1.66 years.

49. Thirty-three and thirty-three hundredths per cent. of the patients with lesions of the vagina are alive with good results; they have been free from the disease for an average of 8.32 years.

50. Sixty-six and sixty-six hundredths per cent. of the patients with lesions of the vagina obtained poor results and lived for an average of 0.61 year.

51. In a consideration of all the organs from the standpoint of the grade of malignancy relative to mortality and exclusive of deaths from unknown causes and deaths post-operatively, epithelioma was the cause of death in 33.33 per cent. of patients in Grade 1, in 81.08 per cent. in Grade 2, in 96.33 per cent. in Grade 3, and 97.29 per cent. in Grade 4.

52. The total good results for all organs were 83.33 per cent. in Grade 1, 45.90 per cent. in Grade 2, 25.00 per cent. in Grade 3, and 12.19 per cent. in Grade 4.

53. The total poor results for all organs were 8.33 per cent. in Grade 1, 49.18 per cent. in Grade 2, 75 per cent. in Grade 3, and 87.80 per cent. in Grade 4.

54. Twenty-three and five hundredths per cent. of all the patients are alive with good results; they have been free from the disease for an average of 8.58 years; 5.08 per cent. of the patients obtained good results and had been free from the disease for an average of 6.34 years at the time of death; 28.13 per cent. obtained good results; 1.35 per cent. are alive with fair results, and 70.50 per cent. obtained poor results and lived for an average of 1.34 years.

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EPITHELIOMA OF THE GENITO-URINARY ORGANS

EPITHELIOMA OF THE GENITO-URINARY ORGANS

Four hundred seventy-three cases (23.65 per cent of 2000 cases of general epithelioma)
from November 1, 1904, to July 22, 1915

	Patients	Per cent.
Number	473	
Females	346	73.15
Males	127	26.84
<i>Lesions of the bladder</i>		
Males	96	80.0 of 120
Female	24	20.0 of 120
<i>Lesions of the urethra</i>		
Females	3	75.0 of 4
Males	1	25.0 of 4
Family history of malignancy	56	11.83 of 473
	Years	
Youngest patient	23	
Oldest patient	86	
Average age of patients	50.04	
<i>Lesions of the cervix</i>		
Youngest	23	
Oldest	69	
Average	47.25	
<i>Lesions of the bladder</i>		
Youngest	29	
Oldest	78	
Average	53.51	
<i>Lesions of the labium</i>		
Youngest	27	
Oldest	86	
Average	57.87	
<i>Lesions of the penis</i>		
Youngest	29	
Oldest	80	
Average	54.1	
<i>Lesions of the vagina</i>		
Youngest	27	
Oldest	65	
Average	46.72	
<i>Lesions of the urethra</i>		
Youngest	44	
Oldest	69	
Average	57.75	
<i>Lesions of the kidney</i>		
One patient	47	
<i>Lesions of the ovary</i>		
One patient	58	

CIVIL STATE.

	Patients	Per cent.
Married	387	81.81 of 473
Widowed	60	12.68 of 473
Single	19	4.01 of 473
Divorced	6	1.27 of 473
Separated	1	0.21 of 473

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued*
CIVIL STATE—*Continued*

	Patients	Per cent.
<i>Lesions of the cervix</i>		
Married	222	82.52 of 269
Widowed	38	14.12 of 269
Single	4	1.48 of 269
Divorced	4	1.48 of 269
Separated	1	0.37 of 269
<i>Lesions of the labium</i>		
Married	24	77.41 of 31
Widowed	5	16.12 of 31
Single	2	6.45 of 31
<i>Lesions of the penis</i>		
Married	25	86.20 of 29
Single	2	6.89 of 29
Divorced	1	3.44 of 29
Widowed	1	3.44 of 29
<i>Lesions of the vagina</i>		
Married	16	88.88 of 18
Widowed	2	11.11 of 18
<i>Occupation (males)</i>		
Farmer	43	33.85 of 127
Merchant	15	11.81 of 127
Manufacturer	8	6.29 of 127
Railroad employee	6	4.72 of 127
Traveling salesman	6	4.72 of 127
Physician	5	3.93 of 127
Other occupations, 35; each under 2 per cent.	44	34.64 of 127
<i>Location of the lesion</i>		
Cervix	269	56.87 of 473
Bladder	120	25.36 of 473
Labium	31	6.55 of 473
Penis	29	6.13 of 473
Vagina	18	3.80 of 473
Urethra	4	0.84 of 473
Kidney	1	0.21 of 473
Ovary*	1	0.21 of 473

DURATION.†

	Years	
<i>Lesions of the cervix</i>		
Longest	8	
Shortest	0.08	
Average	0.79	
<i>Lesions of the bladder</i>		
Longest	20	
Shortest	0.05	
Average	2.60	
<i>Lesions of the labium</i>		
Longest	20	
Shortest	0.12	
Average	1.73	
<i>Lesions of the penis</i>		
Longest	5	
Shortest	0.29	
Average	1.44	

*Epithelioma was primary in a dermoid cyst.

†The duration of the lesions in most of the internal organs is based, for the most part, on the appearance of hemorrhage.

EPITHELIOMA OF THE GENITO-URINARY ORGANS

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued DURATION—Continued

	Years	
<i>Lesions of the vagina</i>		
Longest.....	2	
Shortest.....	0.15	
Average.....	0.69	
<i>Lesions of the urethra</i>		
Longest.....	1.25	
Shortest.....	0.25	
Average.....	0.87	
<i>Lesions of the kidney</i>		
One case.....	2	
<i>Lesions of the ovary</i>		
One case.....	1.33	
<i>Lesions of all organs</i>		
Longest.....	20	
Shortest.....	0.05	
Average.....	1.35	

SIZE

	Patients	Per cent.
<i>Lesions of the cervix</i>		
Large (over 4 cm.).....	164	66.39 of 247
Medium (between 2 cm. and 4 cm.).....	67	27.12 of 247
Small (under 2 cm.).....	16	6.47 of 247
Not stated.....	9	
<i>Lesions of the bladder</i>		
Large (over 4 cm.).....	32	40.50 of 79
Medium (between 2 cm. and 4 cm.).....	41	51.89 of 79
Small (under 2 cm.).....	6	7.59 of 79
Single.....	79	84.04 of 94
Multiple.....	15	15.95 of 94
Not stated.....	15	
<i>Lesions of the labium</i>		
Large (over 4 cm.).....	4	18.18 of 22
Medium (between 2 cm. and 4 cm.).....	13	59.09 of 22
Small (under 2 cm.).....	5	22.73 of 22
Not stated.....	5	
<i>Lesions of the penis</i>		
Large (over 4 cm.).....	5	22.73 of 22
Medium (between 2 cm. and 4 cm.).....	12	54.54 of 22
Small (under 2 cm.).....	5	22.73 of 22
Not stated.....	5	
<i>Lesions of the vagina</i>		
Large (over 4 cm.).....	10	71.42 of 14
Medium (between 2 cm. and 4 cm.).....	4	28.57 of 14
<i>Lesions of the urethra</i>		
Large (over 4 cm.).....	1	
Not stated.....	3	
<i>Lesions of the kidney</i>		
Large (over 4 cm.).....	1	
<i>Lesions of the ovary</i>		
Large (over 4 cm.).....	1	

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued*
PREGNANCIES

	Patients	Per cent.
<i>Lesions of the cervix</i>		
One or more children	163	60.59 of 269
One or more children and one or more miscarriages	65	24.16 of 269
One or more children, miscarriages, and stillbirths	5	1.85 of 269
One or more miscarriages	5	1.85 of 269
One or more miscarriages and premature births	1	0.37 of 269
One or more children and stillbirths	1	0.37 of 269
Married but never pregnant	25	9.29 of 269
Single	4	1.48 of 269
Patients passed the menopause	111	41.26 of 269
<i>Lesions of the labium</i>		
One or more children	21	77.77 of 27
One or more children and one or more miscarriages	3	11.11 of 27
Married but never pregnant	1	3.70 of 27
Single	2	7.40 of 27
Not stated	4	
<i>Lesions of the vagina</i>		
One or more children	12	70.58 of 17
One or more children and one or more miscarriages	3	17.64 of 17
One or more miscarriages	1	5.88 of 17
Married but never pregnant	1	5.88 of 17
Not stated	1	

HEMORRHAGE

	Patients	Per cent.
<i>Lesions of the cervix</i>		
Hemorrhage	250	93.63 of 267
No hemorrhage	17	6.36 of 267
Not stated	2	
<i>Lesions of the bladder</i>		
Hemorrhage	113	94.17 of 120
No hemorrhage	7	5.83 of 120
<i>Lesions of the vagina</i>		
Hemorrhage	16	88.88 of 18
No hemorrhage	2	11.11 of 18
<i>Lesions of the urethra</i>		
Hemorrhage	3	75.00 of 4
No hemorrhage	1	25.00 of 4
<i>Lesions of the kidney</i>		
Hemorrhage	1	

OPERATIONS

	Patients	Per cent.
<i>Lesions of the cervix</i>		
Number	256	95.16 of 269
Hysterectomy, vaginal or abdominal	131	51.17 of 256
Actual cautery, with or without curettage	28	10.93 of 256
Percy cautery, with or without opening abdomen	26	10.15 of 256
Percy cautery followed later by hysterectomy	14	5.46 of 256
One or more actual cauteries followed later by hysterectomy	10	3.90 of 256
Two or more actual cauteries	9	3.51 of 256
Hysterectomy followed later by one or more actual cauteries	8	3.12 of 256
Two or more Percy cauteries	4	1.56 of 256
Percy cautery (one operation) followed later by one or more actual cauteries	3	1.17 of 256

EPITHELIOMA OF THE GENITO-URINARY ORGANS

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued* OPERATIONS—*Continued*

	Patients	Per cent.
<i>Lesions of the cervix—Continued</i>		
Miscellaneous (various combinations of operations).....	23	8.98 of 256
Number on whom hysterectomies were performed	178	69.53 of 256
Number on whom the actual cautery was used (one or more operations).....	76	29.68 of 256
Number on whom the Percy cautery was used (one or more operations).....	51	19.92 of 256
In inoperable condition	12	4.46 of 269
Refused operation.....	1	0.37 of 269
<i>Lesions of the bladder</i>		
Number.....	109	90.83 of 120
Suprapubic cystotomy, excision of the epithelioma with knife immediately followed by actual cautery.....	21	19.26 of 109
Suprapubic cystotomy, excision of the epithelioma with actual cautery	18	16.51 of 109
Suprapubic cystotomy and excision of the epithelioma with knife	7	6.42 of 109
Suprapubic cystotomy and actual cautery	4	3.66 of 109
Suprapubic cystotomy, excision of the epithelioma with Percy cautery	3	2.75 of 109
Miscellaneous (various combinations of operations such as transperitoneal and suprapubic resections of part or all of the bladder, with or without transplantation of one or both ureters, excisions with knife, actual cautery, Percy cautery, fulgurations, and so forth)	56	51.37 of 109
Number in whom the actual cautery was used one or more times	72	66.05 of 109
Number in whom the Percy cautery was used one or more times	7	6.42 of 109
Number in whom from one-fourth to two-thirds of the bladder was resected	26	23.85 of 109
Number in whom the bladder was completely extirpated.....	2	1.83 of 109
Number in whom one or both ureters were transplanted.....	13	11.92 of 109
In inoperable condition	11	9.16 of 120
<i>Lesions of the labium</i>		
Number.....	27	87.09 of 31
Excision with knife.....	5	18.51 of 27
Excision with knife immediately followed by cautery	2	7.40 of 27
Excision with cautery	2	7.40 of 27
Amputation of one labium and excision of the inguinal lymph-nodes on the same side	2	7.40 of 27
Excision with cautery and excision of the inguinal lymph-nodes on the same side	2	7.40 of 27
Miscellaneous (various combinations of operations, such as one or more excisions with the knife, immediately followed by cautery, one or more excisions, with cautery and one or more cauteries, such operations with or without removal of the inguinal lymph-nodes on one or both sides at the same or different operations).	14	51.85 of 27
Number in whom the inguinal lymph-nodes on one or both sides were removed at the same time or different times.....	17	62.96 of 27
In inoperable condition.....	4	12.90 of 31
<i>Lesions of the penis</i>		
Number.....	28	96.55 of 29
Amputation with knife and excision of inguinal lymph-nodes on both sides	13	46.42 of 28
Amputation with knife	2	7.14 of 28
Miscellaneous (various combinations of operations, such as amputation, partial amputation, reamputation with knife or Percy cautery, one or more actual cauteries, excisions with actual cautery or knife, with or without removal of the inguinal lymph-nodes on one or both sides at the same or different operations).	13	46.42 of 28
Number in whom the inguinal lymph-nodes on both sides were removed	19	67.85 of 28

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued*
OPERATIONS—*Continued*

	Patients	Per cent.
<i>Lesions of the penis—Continued</i>		
Number in whom the inguinal lymph-nodes on one side were removed (the other side having been removed elsewhere).....	3	10.71 of 28
Number in whom the inguinal lymph-nodes on one or both sides were removed.....	22	78.57 of 28
In inoperable condition	1	3.44 of 29
<i>Lesions of the vagina</i>		
Number.....	14	77.77 of 18
Excision with knife.....	4	28.57 of 14
Percy cautery.....	3	21.42 of 14
Actual cautery.....	2	14.28 of 14
Hysterectomy with removal of vagina and vulva.....	1	7.14 of 14
Hysterectomy with removal of most of the vagina.....	1	7.14 of 14
Excision of entire posterior wall, anterior wall of rectum and part of bladder.....	1	7.14 of 14
Excision with actual cautery.....	1	7.14 of 14
Excision with knife.....	1	7.14 of 14
In inoperable condition	4	22.22 of 18
<i>Lesions of the urethra</i>		
Number.....	4	100 of 4
Four actual cauteries and one excision with the actual cautery...	1	25.0 of 4
One actual cautery followed immediately by excision with knife..	1	25.0 of 4
Removal of urethra and anterior third of the bladder followed in two years by one excision with knife, immediately followed by actual cautery	1	25.0 of 4
Suprapubic prostatectomy	1	25.0 of 4
<i>Lesions of the kidney</i>		
Number.....	1	
Nephrectomy.....	1	
<i>Lesions of the ovary</i>		
Number.....	1	
Resection of the entire sigmoid (the ovary had been removed elsewhere)	1	

FOUR HUNDRED SEVENTY-THREE EPITHELIOMAS, GRADED ON A BASIS
OF 1 TO 4 ACCORDING TO CELLULAR ACTIVITY

	Patients	Per cent.
Grade 1.....	24	5.07 of 473
Grade 2.....	116	24.52 of 473
Grade 3.....	206	43.55 of 473
Grade 4.....	127	26.84 of 473
<i>Lesions of the cervix</i>		
Grade 2.....	23	8.54 of 269
Grade 3.....	153	56.87 of 269
Grade 4.....	93	34.57 of 269
<i>Lesions of the bladder</i>		
Grade 1.....	21	17.50 of 120
Grade 2.....	44	36.66 of 120
Grade 3.....	32	26.66 of 120
Grade 4.....	23	19.16 of 120
<i>Lesions of the labium</i>		
Grade 2.....	25	80.64 of 31
Grade 3.....	5	16.12 of 31
Grade 4.....	1	3.22 of 31

EPITHELIOMA OF THE GENITO-URINARY ORGANS

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued* FOUR HUNDRED SEVENTY-THREE EPITHELIOMAS GRADED ON A BASIS OF I TO 4 ACCORDING TO CELLULAR ACTIVITY—*Continued*

	Patients	Per cent.
<i>Lesions of the penis</i>		
Grade 1	3	10.34 of 29
Grade 2	20	68.96 of 29
Grade 3	6	20.69 of 29
<i>Lesions of the vagina</i>		
Grade 2	1	5.55 of 18
Grade 3	8	44.44 of 18
Grade 4	9	50.00 of 18
<i>Lesions of the urethra</i>		
Grade 2	2	50.00 of 4
Grade 3	2	50.00 of 4
<i>Lesions of the kidney</i>		
Grade 2	1	
<i>Lesions of the ovary</i>		
Grade 4	1	

GENERAL ULTIMATE RESULTS (ALL ORGANS) Duration of life since last or only operation

Patients concerning whom information was received	337 (76.59 % of 440)
Patients living	72 (21.36 % of 337)
Good result	68 (94.44 % of 72)
Longest duration	16.15 years
Shortest duration	2.72 years
Average duration	8.58 years
Fair result	4 (5.55 % of 72)
Longest duration	8.8 years
Shortest duration	4.25 years
Average duration	6.86 years
Patients dead	265 (78.63 % of 337)
Good result	15 (6.72 % of 223)
Longest duration	11.54 years
Shortest duration	1.93 years
Average duration	6.34 years
Poor result	208 (93.27 % of 223)
Longest duration	8.83 years
Shortest duration	0.08 year
Average duration	1.34 years

Cause of death of patients who recovered from epithelioma (Data from relative or home physician)

	Patients	Per cent.
Known cause	14	93.33 of 15
Cancer of the stomach	2	14.28 of 14
Nephritis	2	14.28 of 14
Tuberculosis	2	14.28 of 14
Cancer of the face and jaw	1	7.14 of 14
Heart disease	1	7.14 of 14
Old age	1	7.14 of 14
Paralysis	1	7.14 of 14
Perforating ulcer of the stomach	1	7.14 of 14
Pneumonia	1	7.14 of 14
Strangulated hernia	1	7.14 of 14
Violence	1	7.14 of 14
Unknown	1	6.66 of 15

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued
GENERAL ULTIMATE RESULTS (ALL ORGANS)—Continued

Cause of death of patients who died in the Clinic following operation

	Patients	Per cent.
Kidney disease	8	
Heart disease	4	
Pneumonia	1	
Miscellaneous (various types of infection associated with or not associated with kidney or heart disease)	10	
	23	5.22 of 440

Cause of death of all patients operated on
(Data from home physician, relative, or pathologic records of the Clinic)

	Patients	Per cent.
Known cause	253	95.47 of 265
Epithelioma	208	82.21 of 253
Kidney disease	10	3.95 of 253
Heart disease	6	2.37 of 253
Pneumonia	3	1.18 of 253
Violence	3	1.18 of 253
Cancer of the stomach	2	0.79 of 253
Operation elsewhere	2	0.79 of 253
Tuberculosis	2	0.79 of 253
Cancer of the face and jaw	1	0.39 of 253
Old age	1	0.39 of 253
Paralysis	1	0.39 of 253
Strangulated hernia	1	0.39 of 253
Ulcer of the intestine	1	0.39 of 253
Ulcer of the stomach	1	0.39 of 253
Miscellaneous (various types of infection associated with or not associated with kidney or heart disease)	11	4.34 of 253
Unknown	12	4.52 of 265
Longest duration	11.54 years	
Shortest duration	0.002 year	
Average duration	1.54 years	
Patients with inoperable epitheliomas	32	6.76 of 473
Patients with inoperable epitheliomas concerning whom information has been received (all dead)	19	59.37 of 32
Patient refused operation after diagnosis had been made (dead) .	1	0.002 of 473

Pregnancy in relation to lesions of the cervix in which the result is known

Patients having been pregnant	164	(91.11 % of 180)
Good result	34	(20.72 % of 164)
Poor result	130	(79.26 % of 164)
Patients not having been pregnant	16	(8.88 % of 180)
Good result	2	(12.50 % of 16)
Poor result	14	(87.50 % of 16)

Data relative to size obtainable in 166 cases of lesions of the cervix

	Small	Medium	Large
Number	3 (1. 8% of 166)	54 (32.53% of 166)	109 (65.66% of 166)
Grade 2	1 (33.33% of 3)	8 (14.81% of 54)	6 (5.50% of 109)
Grade 3	1 (33.33% of 3)	30 (55.55% of 54)	65 (59.63% of 109)
Grade 4	1 (33.33% of 3)	16 (29.62% of 54)	38 (34.86% of 109)
Average duration of lesion (patients living and dead).	0.25 year	0.86 year	0.74 year

EPITHELIOMA OF THE GENITO-URINARY ORGANS

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued

GENERAL ULTIMATE RESULTS (ALL ORGANS)—Continued

Data relative to size obtainable in 166 cases of lesions of the cervix—Continued

	Small	Medium	Large
Patients living	3 (100 % of 3)	17 (31.48% of 54)	9 (8.25% of 109)
Good result	3 (100 % of 3)	17 (100 % of 17)	9 (100 % of 9)
Average duration of lesion . .	0.25 year	1.11 years	0.90 year
Average duration of life since last or only operation . . .	6.26 years	8.84 years	7.8 years
Patients dead		37 (68.51% of 54)	100 (91.74% of 109)
Good result		1 (2.70% of 37)	2 (2.00% of 100)
Average duration of lesion . .		0.33 year	0.87 year
Average duration of life since last or only operation . . .		3.33 years	7.08 years
Poor result		36 (97.29% of 37)	98 (98.00% of 100)
Average duration of lesion . .		0.77 year	0.73 year
Average duration of life since last or only operation . . .		1.64 years	1.41 years
Average duration of life since last or only operation (patients living and dead) . .		3.93 years	1.93 years
Total good result*	100 % of 3	33.33% of 54	10.09% of 109
Total poor result**		66.66% of 54	89.90% of 109

* Patient recovered from epithelioma and is living, or recovered from epithelioma and died from other cause.

** Patient died from epithelioma.

Data relative to size obtainable in fifty-six cases of lesions of the bladder

	Small	Medium	Large
Number	5 (8.92% of 56)	30 (53.57% of 56)	21 (37.50% of 56)
Grade 1	3 (60.00% of 5)	3 (10.00% of 30)	3 (14.28% of 21)
Grade 2	1 (20.00% of 5)	8 (26.66% of 30)	2 (9.52% of 21)
Grade 3		13 (43.33% of 30)	8 (38.09% of 21)
Grade 4	1 (20.00% of 5)	6 (20.00% of 30)	8 (38.09% of 21)
Average duration of lesion (patients living and dead) .	1.37 years	1.67 years	2.35 years
Patients living	3 (60.00% of 5)	12 (40.00% of 30)	5 (23.80% of 21)
Good result	3 (100 % of 3)	12 (100 % of 12)	5 (100 % of 5)
Average duration of lesion . .	1.79 years	1.23 years	2.75 years
Average duration of life since last or only operation . . .	7.83 years	7.09 years	9.24 years
Patients dead	2 (40.00% of 5)	18 (60.00% of 30)	16 (76.19% of 21)
Good result	1 (50.00% of 2)	2 (11.11% of 18)	2 (12.50% of 16)
Average duration of lesion . .	0.41 year	2 years	0.75 year
Average duration of life since last or only operation . . .	6.58 years	7.38 years	7.63 years
Poor result	1 (50.00% of 2)	16 (88.88% of 18)	14 (87.50% of 16)
Average duration of lesion . .	1.08 years	1.96 years	2.44 years
Average duration of life since last or only operation . . .	2.86 years	1.04 years	1.46 years
Average duration of life since last or only operation (patients living and dead) . . .	6.59 years	3.88 years	3.9 years
Total good result	(80.00% of 5)	(46.66% of 30)	(33.33% of 21)
Total poor result	(20.00% of 5)	(53.33% of 30)	(66.66% of 21)

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued*
GENERAL ULTIMATE RESULTS (ALL ORGANS)—*Continued*

Data relative to size obtainable in fifteen cases of lesions of the labium

Small		Medium
Number.....	4 (26.66 % of 15)	11 (73.33 % of 15)
Grade 2.....	2 (50.00 % of 4)	9 (81.81 % of 11)
Grade 3.....	2 (50.00 % of 4)	2 (18.18 % of 11)
Average duration of lesion (patients living and dead)	0.44 year	1.04 years
Patients living	2 (50.00 % of 4)	2 (18.18 % of 11)
Fair result	1 (50.00 % of 2)	
Average duration of lesion	1 year	
Average duration of life since last or only operation	4.25 years	
Good result	1 (50.00 % of 2)	2 (100 % of 2)
Average duration of lesion	0.5 year	2.12 years
Average duration of life since last or only operation	5.68 years	9.66 years
Patients dead.....	2 (50.00 % of 4)	9 (81.81 % of 11)
Poor result	2 (100 % of 2)	9 (100 % of 9)
Average duration of lesion	0.14 year	0.8 year
Average duration of life since last or only operation	1.35 years	3.13 years
Average duration of life since last or only operation (patients living and dead)	3.16 years	4.31 years
Total good result	(25.00 % of 4)	18.18 % of 11)
Total fair result*	(25.00 % of 4)	
Total poor result	(50.00 % of 4)	81.81 % of 11)

* Patient living, with slight recurrence.

Data relative to size obtainable in thirteen cases of lesions of the penis

	Small	Medium	Large
Number	3 (23.07 % of 13)	8 (61.53 % of 13)	2 (15.38 % of 13)
Grade 2	2 (66.66 % of 3)	7 (87.50 % of 8)	1 (50.00 % of 2)
Grade 3	1 (33.33 % of 3)	1 (12.50 % of 8)	1 (50.00 % of 2)
Average duration of lesion (patients living and dead)	0.77 year	1.22 years	2.08 years
Patients living	1 (33.33 % of 3)	2 (25.00 % of 8)	
Fair result		1 (50.00 % of 2)	
Average duration of lesion		0.5 year	
Average duration of life since last or only operation		8.75 years	
Good result.....		1 (50.00 % of 2)	
Average duration of lesion	1.50 years	1 year	
Average duration of life since last or only operation	10.66 years	11.52 years	
Patients dead	2 (66.66 % of 3)	6 (75.00 % of 8)	2 (100 % of 2)
Good result	1 (50.00 % of 2)	2 (33.33 % of 6)	
Average duration of lesion	0.33 year	1.5 years	
Average duration of life since last or only operation	10.05 years	10.41 years	

EPITHELIOMA OF THE GENITO-URINARY ORGANS

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued GENERAL ULTIMATE RESULTS (ALL ORGANS)—Continued

Data relative to size obtainable in thirteen cases of lesions of the penis—Continued

	Small	Medium	Large
Poor result	1 (50.00% of 2)	4 (66.66% of 6)	2 (100 % of 2)
Average duration of lesion	0.5 year	1.32 years	2.08 years
Average duration of life since last or only operation	0.41 year	1.2 years	2.88 years
Average duration of life since last or only operation (patients living and dead) ...	7.04 years	5.74 years	2.88 years
Total good result	66.66% of 3	37.50% of 8	
Total fair result		12.50% of 8	
Total poor result	33.33% of 3	50.00% of 8	100%

Data relative to size obtainable in six cases of lesions of the vagina

	Medium	Large
Number	2 (33.33% of 6)	4 (66.66% of 6)
Grade 3	1 (50.00% of 2)	2 (50.00% of 4)
Grade 4	1 (50.00% of 2)	2 (50.00% of 4)
Average duration of lesion (patients living and dead)	1.62 years	0.62 year
Patients living	2 (100 % of 2)	
Good result	2 (100 % of 2)	
Average duration of lesion	1.62 years	
Average duration of life since last or only operation	8.32 years	
Patients dead		4 (100 % of 4)
Poor result		4 (100 % of 4)
Average duration of lesion		0.62 year
Average duration of life since last or only operation		0.61 year
Average duration of life since last or only operation (patients living and dead)	8.32 years	0.61 year
Total good result	100% of 2	
Total poor result		100 % of 4

Lesions of the labium

Patients with metastasis operated on with removal of inguinal lymph-nodes

Patients concerning whom information was not received	3 (30.00% of 10)
Patients concerning whom information was received	7 (70.00% of 10)
Grade 2	Grade 3
Patients living	1 (14.28% of 7)
Good result	1 (100 % of 1)
Patients dead	6 (85.71% of 7)
Poor result	5 (83.33% of 6)
Total good result	1 (16.16% of 6)
Total poor result	1 (14.28% of 7)
Total poor result	6 (85.71% of 7)
Cause of Death	
Epithelioma	6 (100 % of 6)

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued*
GENERAL ULTIMATE RESULTS (ALL ORGANS)—*Continued*

Lesions of the labium—Continued

Patients without metastasis operated on with removal of inguinal lymph-nodes			
Patients concerning whom information was not received.....			1 (14.28% of 7)
Patients concerning whom information was received.....			6 (85.71% of 7)
	Grade 2	Grade 3	
Patients living.....			2 (33.33% of 6)
Good result.....	1 (100 % of 1)		
Fair result.....	1 (100 % of 1)		
Patients dead.....			4 (66.66% of 6)
Poor result.....	2 (66.66% of 3)	1 (33.33% of 3)	
Cause unknown.....	1		
Total good result.....			1 (20.00% of 5)
Total fair result.....			1 (20.00% of 5)
Total poor result.....			3 (60.00% of 5)
	Cause of death		
Epithelioma.....			3 (100 % of 3)

Patients operated on without removal of inguinal lymph-nodes			
Patients concerning whom information was not received.....			4 (36.36% of 11)
Patients concerning whom information was received.....			7 (63.63% of 11)
	Grade 2	Grade 3	
Patients living.....			1 (14.28% of 7)
Good result.....	1 (100% of 1)		
Patients dead.....			6 (85.71% of 7)
Poor result.....	2 (50.00% of 4)	2 (50.00% of 4)	
Postoperative death.....	1		
Cause unknown.....	1		
Total good result.....			1 (20.00% of 5)
Total poor result.....			4 (80.00% of 5)
	Cause of death		
Epithelioma.....			4 (80.00% of 5)
Cellulitis of the vulva and thigh.....			1 (20.00% of 5)

Patients with metastasis and patients without metastasis operated on with removal of inguinal lymph-nodes and patients operated on without removal of inguinal lymph-nodes

	Grade 2	Grade 3
Patients with metastasis.....	9 (90.00% of 10)	1 (10.00% of 10)
Patients without metastasis.....	5 (71.42% of 7)	2 (28.57% of 7)
Patients without removal of inguinal lymph-nodes at operation.....	9 (81.81% of 11)	2 (18.18% of 11)

Duration of lesion at the time of patient's examination at the Clinic

	Longest	Shortest	Average
Patients with metastasis.....	2 years	1.66 years	0.99 year
Patients without metastasis ..	5 years	0.33 year	1.51 years
Patients without removal of inguinal lymph-nodes.....	4 years	0.12 year	1.3 years

Size of lesion at the time of patient's examination at the Clinic

	Small	Medium	Large
Patients with metastasis.....	2 (33.33% of 6)	3 (50.00% of 6)	1 (16.66% of 6)
Patients without metastasis ..	2 (33.33% of 6)	4 (66.66% of 6)	
Patients without removal of inguinal lymph-nodes.....	3 (27.27% of 11)	7 (63.63% of 11)	1 (9.09% of 11)
Not stated.....	5		

EPITHELIOMA OF THE GENITO-URINARY ORGANS

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued GENERAL ULTIMATE RESULTS (ALL ORGANS)—Continued

Lesions of the labium—Continued

Duration of life after operation of patients with metastasis

Patients concerning whom information was not received	3 (30.00% of 10)
Patients concerning whom information was received	7 (70.00% of 10)
Grade 2	Grade 3
Patients living	1 (14.28% of 7)
Good result	9.32 years
Patients dead	6 (85.71% of 7)
Poor result	All grades
5 (83.33% of 6)	1 (16.66% of 6)
Longest duration	3.7 years
Shortest duration	0.16 year
Average duration	3.7 years
	0.5 year
	1.07 years

Duration of life after operation of patients without metastasis

Patients concerning whom information was not received	1 (14.28% of 7)
Patients concerning whom information was received	6 (85.71% of 7)
Grade 2	Grade 3
Patients living	2 (33.33% of 6)
Good result	5.68 years
Fair result	4.25 years
Patients dead	4 (66.66% of 6)
Poor result	1 (33.33% of 3)
Cause unknown	All grades
2 (66.66% of 3)	1 (33.33% of 3)
Longest duration	6.37 years
Shortest duration	3.07 years
Average duration	4.72 years
	3 years
	6.37 years
	3.07 years
	4.15 years

Duration of life of patients after operation without removal of inguinal lymph-nodes

Patients concerning whom information was not received	4 (36.36% of 11)
Patients concerning whom information was received	7 (63.63% of 11)
Grade 2	Grade 3
Patients living	1 (18.18% of 7)
Good result	10.01 years
Patients dead	6 (81.81% of 7)
Poor result	2 (50.00% of 4)
Post-operative death	2 (50.00% of 4)
Cause unknown	All grades
2 (50.00% of 4)	2 (50.00% of 4)
Longest duration	8.83 years
Shortest duration	1.01 years
Average duration	4.92 years
	2.54 years
	0.84 year
	1.69 years
	3.30 years

Lesions of the penis

Patients with metastasis operated on with removal of inguinal lymph-nodes

Patients concerning whom information was not received	1 (25.00% of 4)
Patients concerning whom information was received	3 (75.00% of 4)
Grade 2	Grade 3
Patients dead	3 (100 % of 3)
Poor result	1 (33.33% of 3)
Total poor result	3 (100 % of 3)
Cause of death	
Epithelioma	3 (100 % of 3)

Patients without metastasis operated on with removal of inguinal lymph-nodes

Patients concerning whom information was not received	6 (33.33% of 18)		
Patients concerning whom information was received	12 (66.66% of 18)		
	Grade 1	Grade 2	Grade 3
Patients living	5 (41.66% of 12)		
Good result	2 (50.00% of 4)		2 (50.00% of 4)
Fair result	1 (100 % of 1)		

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued*
GENERAL ULTIMATE RESULTS (ALL ORGANS)

Lesions of the penis—Continued

Patients without metastasis operated on with removal of inguinal lymph-nodes—*Continued*

	Grade 1	Grade 2	Grade 3	
Patients dead				7 (58.33% of 12)
Good result		2 (66.66% of 3)	1 (33.33% of 3)	
Poor result		2 (66.66% of 3)	1 (33.33% of 3)	
Cause unknown. 1				
Total good result				7 (63.63% of 11)
Total fair result				1 (9.09% of 11)
Total poor result				3 (27.27% of 11)
		Cause of death		
Epithelioma				3 (50.00% of 6)
Old age				1 (16.66% of 6)
Paralysis				1 (16.66% of 6)
Cancer of the face				1 (16.66% of 6)

Patients operated on without removal of inguinal lymph-nodes

Patients concerning whom information was not received			3 (50.00% of 6)
Patients concerning whom information was received			3 (50.00% of 6)
	Grade 2	Grade 3	
Patients dead			3 (100 % of 3)
Poor result	2 (66.66% of 3)	1 (33.33% of 3)	
Total poor result			3 (100 % of 3)

Patients with metastasis and patients without metastasis operated on with removal of inguinal lymph-nodes and patients operated on without removal of inguinal lymph-nodes

	Grade 1	Grade 2	Grade 3
With metastasis		3 (75.00% of 4)	1 (25.00% of 4)
Without metastasis	2 (11.11% of 18)	12 (66.66% of 18)	4 (22.22% of 18)
Without removal of inguinal lymph-nodes at operation ..	1 (16.66% of 6)	4 (66.66% of 6)	1 (16.66% of 6)

Duration of lesion at the time of patient's examination at the Clinic

	Longest	Shortest	Average
Patients with metastasis	1.5 years	0.29 year	0.69 year
Patients without metastasis ..	5 years	0.33 year	1.77 years
Patients without removal of inguinal lymph-nodes	2 years	0.50 year	1.09 years

Size of lesion at the time of patient's examination at the Clinic

	Small	Medium	Large
Patients with metastasis	1 (25.00% of 4)	3 (75.00% of 4)	
Patients without metastasis ..	3 (21.42% of 14)	8 (57.14% of 14)	3 (21.42% of 14)
Patients without removal of inguinal lymph-nodes at operation	1 (25.00% of 4)	1 (25.00% of 4)	2 (50.00% of 4)
Not stated	6		

Duration of life after operation of patients with metastasis

Patients concerning whom information was not received			1 (25.00% of 4)
Patients concerning whom information was received			3 (75.00% of 4)
	Grade 2	Grade 3	
Patients dead			3 (100% of 3)
Poor result	2 (66.66% of 3)	1 (33.33% of 3)	
Longest duration	1.03 years	0.41 year	All grades
Shortest duration	0.3 year		1.03 years
Average duration	0.66 year		0.3 year
			0.58 year

EPITHELIOMA OF THE GENITO-URINARY ORGANS

EPITHELIOMA OF THE GENITO-URINARY ORGANS—*Continued* GENERAL ULTIMATE RESULTS (ALL ORGANS)—*Continued*

Lesions of the penis—Continued

Duration of life after operation of patients without metastasis

Patients concerning whom information was not received			6 (33.33% of 18)
Patients concerning whom information was received			12 (66.66% of 18)
	Grade 2	Grade 3	
Patients living			5 (41.66% of 12)
Good result	2 (50.00% of 4)	2 (50.00% of 4)	
Longest duration	11.52 years	12.9 years	All grades 12.9 years
Shortest duration	10.60 years	6.64 years	6.64 years
Average duration	11.06 years	9.77 years	10.41 years
Fair result	1 (100% of 1)		
Longest duration	8.8 years		
Patients dead			7 (58.33% of 12)
Good result	2 (66.66% of 3)	1 (33.33% of 3)	
Longest duration	10.05 years	1.93 years	All grades 10.05 years
Shortest duration	8.89 years		8.89 years
Average duration	9.47 years		6.96 years
Poor result	2 (66.66% of 3)	1 (33.33% of 3)	
Longest duration	2 years	2.35 years	2.35 years
Shortest duration	1.48 years		1.48 years
Average duration	1.74 years		1.94 years
Cause unknown	1		

Duration of life of patients after operation without removal of inguinal lymph-nodes

Patients concerning whom information was not received			3 (50.00% of 6)
Patients concerning whom information was received			3 (50.00% of 6)
	Grade 2	Grade 3	
Patients dead			3 (100 % of 3)
Poor result	2 (66.66% of 3)	1 (33.33% of 3)	
Longest duration	1.62 years	5.68 years	All grades 5.68 years
Shortest duration	0.08 year		0.08 year
Average duration	0.85 year		2.46 years

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued
GENERAL ULTIMATE RESULTS (ALL ORGANS)—Continued

Lesions of the cervix

Results following operation according to grade

	Grade 2	Grade 3	Grade 4	All grades
Patients concerning whom information was received.	16 (69.56% of 23)	108 (73.97% of 146)	67 (77.01% of 87)	
Patients living	7 (43.75% of 16)	20 (18.51% of 108)	5 (7.46% of 67)	
Good result	7 (100% of 7)	20 (100% of 20)	5 (100% of 5)	32 (17.77% of 180)
Patients dead	9 (56.25% of 16)	88 (81.48% of 108)	62 (92.53% of 67)	
Good result	1 (12.5% of 8)	2 (2.43% of 82)	1 (1.72% of 58)	4 (2.22% of 180)
Poor result.	7 (87.50% of 8)	80 (97.56% of 82)	57 (98.27% of 58)	144 (80.00% of 180)
Patients dead who obtained good results and patients dead who obtained poor results				
Postoperative death	1			148 (82.22% of 180)
Cause of death not stated				
Total good result.	8 (53.33% of 15)	22 (21.56% of 102)	6 (9.52% of 63)	36 (20.00% of 180)
Total poor result.	7 (46.66% of 15)	80 (78.43% of 102)	57 (90.47% of 63)	144 (80.00% of 180)

Lesions of the bladder

Results following operation according to grade

	Grade 1	Grade 2	Grade 3	Grade 4	All grades
Patients concerning whom information was received	16 (76.19% of 21)	34 (87.17% of 39)	26 (92.85% of 28)	21 (100% of 21)	
Patients living	9 (56.25% of 16)	10 (29.41% of 34)	7 (26.92% of 26)	2 (9.52% of 21)	
Good result	8 (88.89% of 9)	9 (90.00% of 10)	7 (100% of 7)	2 (100% of 2)	
Pair result	1 (11.11% of 9)	1 (10.00% of 10)			26 (37.14% of 70) 2 (2.85% of 70)
Patients dead	7 (43.75% of 16)	24 (70.58% of 34)	19 (73.07% of 26)	19 (90.47% of 21)	
Good result	2 (66.66% of 3)	4 (40.00% of 10)	1 (6.25% of 16)	1 (7.69% of 13)	8 (11.42% of 70)
Poor result	1 (33.33% of 3)	6 (60.00% of 10)	15 (93.75% of 16)	12 (92.30% of 13)	34 (48.57% of 70)
Patients dead who obtained good results and patients dead who obtained poor results					
Postoperative deaths	1	9	2	4	42 (60.00% of 70)
Cause of death not stated	3	5	1	2	

Total good result.....	10 (83.33% of 12)	13 (65.00% of 20)	8 (34.78% of 23)	3 (20.00% of 15)	34 (48.57% of 70)
Total fair result.....	1 (8.33% of 12)	1 (5.00% of 20)			2 (2.85% of 70)
Total poor result.....	1 (8.33% of 12)	6 (30.00% of 20)	15 (65.21% of 23)	12 (80.00% of 15)	34 (48.57% of 70)

Lesions of the labium

Results following operation according to grade

	Grade 2		Grade 3	All grades
Patients concerning whom information was received.....	16 (72.72% of 22)		4 (80.00% of 5)	3 (17.64% of 17)
Patients living.....	4 (25.00% of 16)			1 (5.88% of 17)
Good result.....	3 (75.00% of 4)			
Fair result.....	1 (25.00% of 4)			
Patients dead.....	12 (75.00% of 16)		4 (100% of 4)	13 (76.47% of 17)
Poor result.....	9 (100% of 9)		4 (100% of 4)	
Postoperative death.....	1			
Cause of death not stated.....	2			
Total good result.....	3 (23.06% of 13)			3 (17.64% of 17)
Total fair result.....	1 (7.69% of 13)			1 (5.88% of 17)
Total poor result.....	9 (69.23% of 13)		4 (100% of 4)	13 (76.47% of 17)

Lesions of the penis

Results following operation according to grade

	Grade 1		Grade 2	Grade 3	All grades
Patients concerning whom information was received.....	1 (33.33% of 3)		11 (57.89% of 19)	6 (100% of 6)	4 (23.52% of 17)
Patients living.....			3 (27.27% of 11)	2 (33.33% of 6)	1 (5.88% of 17)
Good result.....			2 (66.66% of 3)	2 (100% of 2)	
Fair result.....			1 (33.33% of 3)		
Patients dead.....	1 (100% of 1)		8 (72.72% of 11)	4 (66.66% of 6)	3 (17.64% of 17)
Good result.....			2 (25.00% of 8)	1 (25.00% of 4)	9 (52.94% of 17)
Poor result.....			6 (75.00% of 8)	3 (75.00% of 4)	12 (70.58% of 17)
Patients dead who obtained good results and patients dead who obtained poor results.....					
Cause of death not stated.....	1				

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued
GENERAL ULTIMATE RESULTS (ALL ORGANS)—Continued

<i>Lesions of the penis—Continued</i>			
Results following operation according to grade—Continued			
Total good result	4 (36.36% of 11)	3 (50.00% of 6)	7 (41.16% of 17)
Total fair result	1 (9.09% of 11)		1 (5.88% of 17)
Total poor result	6 (54.54% of 11)	3 (50.00% of 6)	9 (52.94% of 17)

Lesions of the vagina

Results following operation according to grade			
	Grade 3	Grade 4	All grades
Patients concerning whom information was received	3 (50.00% of 6)	3 (42.85% of 7)	
Patients living	1 (33.33% of 3)	1 (33.33% of 3)	
Good result	1 (100% of 1)	1 (100% of 1)	2 (33.33% of 6)
Patients dead			
Poor result	2 (66.66% of 3)	2 (66.66% of 3)	4 (66.66% of 6)
Total good result	2 (100% of 2)	2 (100% of 2)	2 (33.33% of 6)
Total poor result	1 (33.33% of 3)	1 (33.33% of 3)	2 (33.33% of 6)
	2 (66.66% of 3)	2 (66.66% of 3)	4 (66.66% of 6)

Lesions of the urethra

Results following operation according to grade			
	Grade 2	Grade 3	All grades
Patients concerning whom information was received	1 (50.00% of 2)	2 (100% of 2)	
Patients living		1 (50.00% of 2)	
Good result		1 (100% of 1)	1 (33.33% of 3)
Patients dead			
Poor result	1 (100% of 1)	1 (50.00% of 2)	2 (66.66% of 3)
Total good result	1 (100% of 1)	1 (100% of 1)	
Total poor result	1 (100% of 1)	1 (50.00% of 2)	

Lesions of the kidney
Results following operation according to grade

	Grade 2
Patients concerning whom information was received	1 (100 % of 1)
Patient dead	1 (100 % of 1)
Poor result	1 (100 % of 1)

Lesions of the ovary
Results following operation according to grade

	Grade 4
Patients concerning whom information was received	1 (100 % of 1)
Patient dead	1 (100 % of 1)
Poor result	1 (100 % of 1)

LESIONS OF ALL ORGANS

Results following operation according to grade

	Grade 1	Grade 2	Grade 3	Grade 4	All grades
Patients concerning whom information was received	17 (70.83 % of 24)	79 (73.83 % of 107)	149 (77.20 % of 193)	92 (80.00 % of 115)	68 (23.05 % of 295)
Patients living	9 (52.94 % of 17)	24 (30.37 % of 79)	31 (20.80 % of 149)	8 (8.69 % of 92)	4 (1.35 % of 295)
Good result	8 (88.88 % of 9)	21 (87.50 % of 24)	31 (100 % of 31)	8 (100 % of 8)	
Poor result	1 (11.11 % of 9)	3 (12.50 % of 24)			
Patients dead	8 (47.05 % of 17)	55 (69.65 % of 79)	118 (79.10 % of 149)	84 (91.30 % of 92)	15 (5.08 % of 295)
Good result	2 (66.66 % of 3)	7 (18.91 % of 37)	4 (3.66 % of 109)	2 (2.70 % of 74)	208 (70.50 % of 295)
Poor result	1 (33.33 % of 3)	30 (81.08 % of 37)	105 (96.33 % of 109)	72 (97.29 % of 74)	
Postoperative deaths	1	11	6	5	
Cause of death not stated	4	7	3	5	
Patients dead who obtained good results and patients dead who obtained poor results					
Total good result	10 (83.33 % of 12)	28 (45.90 % of 61)	35 (25.00 % of 140)	10 (12.19 % of 82)	223 (75.59 % of 295)
Total fair result	1 (8.33 % of 12)	3 (4.91 % of 61)			83 (28.13 % of 295)
Total poor result	1 (8.33 % of 12)	30 (49.18 % of 61)	105 (75.00 % of 140)	72 (87.80 % of 82)	4 (1.35 % of 295)
					208 (70.50 % of 295)

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued
 LESIONS OF ALL ORGANS—Continued

Lesions of the cervix

Duration of life after operation according to grade

Patients concerning whom information was received					
	Grade 2	Grade 3	Grade 4	All grades	
Patients living					
Good result	7	20	5		32
Longest duration	14.11 years	16.15 years	15.62 years		
Shortest duration	6.11 years	5.25 years	5.76 years		
Average duration	9.64 years	9.40 years	8.59 years		
Patients dead					
Good result	1	2	1		148
Longest duration		10.00 years			
Shortest duration		4.16 years			
Average duration		7.08 years			
Poor result		80			
Longest duration	3.33 years	7.19 years	6.72 years		
Shortest duration	2.37 years	0.12 year	57		
Average duration	1.32 years	1.39 years	0.22 year		
			1.12 years		
Average duration of life of all patients (living and dead) who obtained good results					1.27 years
					8.96 years

Lesions of the bladder

Duration of life after operation according to grade

Patients concerning whom information was received					
	Grade 1	Grade 2	Grade 3	Grade 4	All grades
Patients living					
Good result	8	9	7	2	
Longest duration	14.7 years	12.7 years	11.09 years	5.75 years	
Shortest duration	3.58 years	2.72 years	5.4 years	5.67 years	
Average duration	8.08 years	7.29 years	7.78 years	5.71 years	
Fair result	1	1			
Longest duration	7.65 years	6.75 years			
Average duration					
Average duration of life of all patients (living and dead) who obtained good results					7.54 years
					7.2 years

EPITHELIOMA OF THE GENITO-URINARY ORGANS

Patients dead.....	2	6.58 years	4	11.54 years	1	9.27 years	1	6.00 years	42
Good result.....		6.10 years		2.15 years					
Longest duration....		6.34 years		5.52 years					
Shortest duration....									
Average duration...	1	2.86 years	6	2.65 years	15	3.75 years	12	2.45 years	6.26 years
Poor result.....				0.10 year		0.17 year		0.15 year	
Longest duration....				1.35 years		1.28 years		0.95 year	
Shortest duration....									
Average duration...									1.22 years
Average duration of life of all patients (living and dead) who obtained good results..... 7.24 years									

Lesions of the labium

Duration of life after operation according to grade

Patients concerning whom information was received.....	All grades								17
Patients living.....									
Good result.....									
Longest duration....	3								4
Shortest duration....	9.32 years								
Average duration....	5.68 years								
Fair result.....	1								
Longest duration....	4.25 years								
Patients dead.....									13
Poor result.....									
Longest duration....	9								4
Shortest duration....	8.83 years								3.0 years
Average duration....	0.50 year								0.16 year
	2.84 years								1.63 years
									2.47 years

Lesions of the penis

Duration of life after operation according to grade

Patients concerning whom information was received.....	All grades								17
Patients living.....									
Good result.....									
Longest duration....	2								5
	11.52 years								
									2
									12.90 years

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued
 LESIONS OF ALL ORGANS—Continued

Lesions of the penis—Continued
 Duration of life after operation according to grade—Continued

	Grade 2	Grade 3	All grades
Shortest duration	10.66 years	6.64 years	
Average duration	11.09 years	9.76 years	10.42 years
Fair result	1		
Longest duration	8.80 years		
Patients dead			12
Good result	2	1	
Longest duration	10.05 years	1.93 years	
Shortest duration	8.89 years		
Average duration	9.47 years	3	6.95 years
Poor result	6		
Longest duration	2.0 years	5.68 years	
Shortest duration	0.08 year	0.41 year	
Average duration	1.08 years	2.81 years	1.66 years
Average duration of life of all patients (living and dead) who obtained good results			8.94 years

Lesions of the vagina

Duration of life after operation according to grade

	Grade 3	Grade 4	All grades
Patients concerning whom information was received			6
Patients living			
Good result	1	1	2
Longest duration	10.92 years	5.73 years	
Average duration			8.32 years
Patients dead	2	2	4
Poor result			
Longest duration	0.92 year	0.41 year	
Shortest duration	0.79 year	0.33 year	
Average duration	0.85 year	0.37 year	0.61 year

Lesions of the urethra

Duration of life after operation according to grade

Patients concerning whom information was received.....		Grade 2	Grade 3	All grades	3
Patients living .....		.....	.....	.....	I
Good result .....		.....	.....	.....	I
Longest duration.....		.....	.....	.....	5.56 years
Patients dead .....		.....	.....	.....	2
Poor result .....		.....	.....	.....	I
Longest duration.....		I	0.35 year	.....	3.41 year
Average duration .....		.....	.....	.....	1.88 years

Lesions of the kidney

Duration of life after operation according to grade

Patients concerning whom information was received.....		Grade 2
Patients living .....		.....
Good result .....		.....
Longest duration.....		.....
Patients dead .....		.....
Poor result		I
Longest duration.....		0.33 year

Lesions of the ovary

Duration of life after operation according to grade

Patients concerning whom information was received.....		Grade 4
Patients living .....		.....
Good result .....		.....
Longest duration.....		.....
Patients dead .....		.....
Poor result		I
Longest duration.....		0.75 year

EPITHELIOMA OF THE GENITO-URINARY ORGANS—Continued

Lesions of all Organs

Duration of life after operation according to grade

Patients concerning whom information was received					295
Grade 1	Grade 2	Grade 3	Grade 4	All grades	
Patients living					
Good result.....	8	31	8	72	
Longest duration...	14.7 years	16.15 years	15.62 years		
Shortest duration...	3.58 years	5.40 years	5.67 years		
Average duration...	8.08 years	8.98 years	7.51 years		
Fair result.....					
1	3				8.58 years
Longest duration...	7.65 years				
Shortest duration					
Average duration					
Patients dead					
Good result.....	2	4	2	223	
Longest duration...	6.58 years	10.00 years	6.72 years		
Shortest duration...	6.10 years	1.93 years	6.00 years		
Average duration...	6.34 years	6.34 years	6.30 years		6.34 years
Poor result.....					
1	30	105	72		
Longest duration...	2.86 years	7.19 years	3.91 years		
Shortest duration...		0.12 year	0.15 year		
Average duration...		1.43 years	1.06 years		1.34 years
Average duration of life of all patients (living and dead) who obtained good results.....					8.17 years

CARCINOMATOUS PAPILLOMA OF THE RENAL PELVIS*

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CERTAIN clinical and pathological features make the case herein reported one of unusual interest. They serve to emphasize the difficulty in making the diagnosis, and they throw some light on the clinical nature of this apparently rare condition. At the same time they clarify somewhat our conception of its pathology, concerning which so much confusion exists in the literature, particularly from the standpoint of its nomenclature.

The chief points of interest in this case are:

1. The difficulty in obtaining the diagnosis on account of the complete absence of hæmaturia and vagueness of many other symptoms immediately referable to kidney tumor.
2. The value and difficulty of pyelography in the diagnosis of kidney tumor.
3. The extensive destruction of the kidney brought about by the growth originating from the pelvic epithelium.
4. The marked fibrous tissue production, scirrhus-like nature of the papilloma, when invading and destroying the kidney tissue.
5. The absence of any discoverable metastasis up to this time, nine months after operation, notwithstanding the presence of tumor thrombi in the veins of the kidney parenchyma.

CASE REPORT.—Mr. R. G. P. (W. P. H., No. 5649), a broker, married, aged thirty-eight, was first seen by one of us (L. H. L.) at 6 P.M. December 31, 1920, in consultation with his physician, Dr. R. T. Hood. During the preceding week he had been vaguely conscious of a sensation of fulness and heaviness, but no pain, in the upper left abdomen. Aside from this he had been in his usual good health until four hours prior to his admission to the hospital, when he was suddenly attacked by weakness, followed almost immediately by excruciating stabbing pain in the left hypochondrium, radiating downward and backward over the crest of the ilium, but not to the groin or testicle. There had been no bladder irritability, although he had voided once since the attack began, when the urine showed no gross changes from the normal. During the four hours morphine had been administered twice with but little effect upon the intensity of pain. While on the way to the hospital he had vomited twice.

Eighteen months before Mr. P. had suffered a somewhat similar attack of pain in the left upper abdomen with the same radiation. This attack had lasted but half an hour, was attributed to indigestion, and was apparently relieved by

* Read before the Philadelphia Academy of Surgery, October 3, 1921.

the application of an ice bag to the side and Jamaica ginger internally. There had been no disturbance of micturition at this time, nor during the interval between the attacks. Never to his knowledge had the urine contained blood.

With this exception there was nothing suggestive in the past history of this patient. Aside from habitual constipation and constant employment of cathartics, there were no symptoms referable to the gastro-intestinal tract. His appetite had remained good and his weight, 145 pounds, had not varied. During the past five years his complexion, formerly clear and fair, had become sallow, but during this time his occupation kept him confined indoors with but little opportunity for exercise and proper elimination. Two years before he had contracted a Neisserian infection with a resulting chronic prostatitis for which he had been treated irregularly. He was moderate and regular in his habits. There was nothing significant in the family history.

When seen at the hospital Mr. P. was still suffering from what had evidently been profound shock. His features were pinched, his expression anxious, his attitude nervous, while he complained of the stabbing pain in the left hypochondrium. The temperature was 98° Fahrenheit, pulse 110, respirations thirty-two. The mucous surfaces were pale, his skin cool, moist, and distinctly sallow. The conjunctivæ were clear. The general nutrition was good though his musculature showed the results of a sedentary life.

The abdomen was not distended, but diaphragmatic respiration, especially on the left, was greatly inhibited. Efforts at deep inspiration increased the paroxysms of pain. Tenderness and rigidity of the left upper abdomen resisted deep palpation or the determination of a mass. The rigidity and tenderness were confined to the left and examination of the remaining abdomen was negative. There was definite although not extreme tenderness in the left costo-vertebral angle, but none along the course of the ureter. The abdomen was tympanitic throughout, but peristalsis somewhat inhibited.

Examination of the chest was entirely negative except at the left base posteriorly, where an area of dullness extended to the upper border of the tenth rib. Over this area the breath sounds were indistinct. Vocal and tactile fremitus, however, were not increased and no râles or pleural rub could be elicited. There were no abnormal cardio-vascular findings. Blood-pressure was 150 mm. systolic, 85 mm. diastolic.

Rectal examination of the prostate showed this gland to be moderately enlarged, somewhat boggy and tender. The urine upon admission was cloudy, acid, had a specific gravity of 1.020, showed a trace of albumen, no sugar, contained a few granular casts, some epithelial cells, no red blood-cells and few white blood-cells. Examination of the blood revealed a leucocytosis of 16,200, a differential count of eighty-eight per cent. polymorphonuclears, eight per cent. small lymphocytes, and four per cent. large mononuclears. There was seventy per cent. hæmoglobin, and 3,350,000 red cells. A provisional diagnosis of pyonephrosis with ureteral obstruction from stone or kink was made and the patient placed under the appropriate palliative treatment.

On the following day he was much improved. The pain had subsided to a dull, heavy aching. He had voided 1100 c.c. during the twenty-four hours following admission. This urine was clear, with a specific gravity of 1.023, was negative for albumen, contained many white blood-cells, only an occasional red blood-cell, and no casts. The rigidity of the upper abdomen had disappeared and a distinct mass having the outlines of the kidney, but much enlarged and very tender, could be easily palpated. On January 3, 1921, the phenolsulphonephthalein functional test of the bladder urine showed 63.6 per cent. during the first hour, and a total of 76.8 per cent. for the two hours.

Cystoscopic examination by Dr. A. I. Murphy showed a bladder of normal

CARCINOMATOUS PAPILLOMA OF THE RENAL PELVIS

capacity, with no undue irritability, a moderate trigonitis, a normal vesicle sphincter and no evidence of calculus or tumor. Both ureteral orifices were normal in appearance, but nothing was coming from the left ureter. The ureters were catheterized and a specimen obtained from the right for examination. No flow was obtained from the left ureter.

X-ray examination revealed normal conditions of the right kidney in every respect. Collargol was instilled into the left ureter with ease, but apparently most of the solution escaped back into the bladder from around the catheter. It was not until increased force was used for the injection that a pyelogram of importance was obtained. The interpretation of it, however, was quite difficult. There was, namely, a 3-shaped shadow with vague and irregular outlines, and leaving large "defects in filling" the pelvis. This shadow was somewhat thicker in its upper portions. The entire ureter was slightly but uniformly dilated (Fig. 8). The urine from the right kidney contained some amorphous substances, an occasional red blood-cell and white blood-cell, no casts, and some epithelial cells. Smear and culture were negative for bacteria, including tubercle bacilli.

From this time on up to the day of operation there was a gradual improvement in the patient's general condition. He voided 1400 to 1500 c.c. of urine daily, which continued to contain a few pus cells, but inasmuch as nothing was coming from the left ureter, this was attributed to the prostatic condition, even though at this time the possibility of pyonephrosis was thought of. Immediately following the cystoscopic examination red blood-cells were found in very few numbers, as would be expected. There was no recurrence of the pain and the sensation of fullness and the aching in the left hypochondrium had nearly disappeared. There were no changes in the palpable tumor in the last days prior to operation.

Operation.—On January 10, 1921, the kidney was exposed through the ordinary lumbar incision. Upon exposure the kidney was found to be greatly enlarged, semi-cystic to palpation and quite firmly glued to the surrounding structures by inflammatory adhesions, especially at the upper pole, where it was separated with difficulty. The major portions of the organ lay above the level of the costal margin, pushing the diaphragm upward and obviously accounting for the physical findings at the left base resulting from compression of the corresponding portion of the lung. The delivery of so large a kidney through the lumbar incision was accomplished only with difficulties, increased by the efforts to avoid rupture of the cystic tumor. At the instant of delivery a small rent did occur in the capsule through which a considerable quantity of thick, hemorrhagic fluid escaped. Examination of the pelvis showed this to be dilated and cystic down to 3 or 4 cm. below the uretero-pelvic juncture. Below this the ureter was normal in size and appearance. No stone could be palpated. The vessels of the pedicle were normal. The large veins were not thrombotic and no enlarged glands were palpable. About 7 cm. of the upper ureter were removed with the kidney. The wound was closed with drainage, which had been entirely removed on the fifth day. At the end of the week the stitches were removed, and healing was complete. The patient enjoyed an uneventful recovery. Mr. P. was discharged from the hospital on January 29th. Since that time he has been seen frequently. He has gained some ten pounds in weight, has worked daily since March, and is apparently in good health.

Pathological Report.—Macroscopical examination: Specimen consists of a kidney, which weighs 610 grams. Measures 19 x 10 x 8 cm. The kidney is uniformly enlarged. Its characteristic shape is lost on account of the ragged surface, which is covered with thick fibrous bands, especially on the lower half, where the fatty capsule is inseparable from the kidney itself. The upper half has a dark, reddish-brown color and is cystic in appearance. There is a narrow tear (1 cm.

in length) from which thick, hemorrhagic fluid is oozing. The lower half is very firm. The stump of the ureter is imbedded in large amount of scar tissue surrounding the pelvis. The ureter measures about 7 cm. in length. The ureter is club-shaped and shows a swelling towards the pelvis. At the surgical incision it has normal calibre. On cross-section of the specimen a large amount of dark brown, thick, hemorrhagic material is discharged. After washing off the exudate a villous growth is seen lining the upper portion of the ureter and pelvis (Fig. 1). This growth is apparently replacing most of the kidney. Surrounding the upper portions of the kidney and separating this from the capsule there is a round hemorrhagic cavity. In the lower portions some uniformly brown kidney tissue is seen. The periphery of this has no sharp outlines and cannot be distinguished from the scar tissue surrounding it. This scar tissue consists mostly of tendinous fibrous tissue interwoven with transparent gray tissue and shows gradual transition into the surrounding fatty tissue. The structure of the kidney is entirely lost. There is a large cavity occupying most of the kidney. This is subdivided by outstanding fibrous columns, which thus remind one of the structure of hydronephrosis, overshadowed by the growth. A papillary growth lines the surface of the cavity, which is continuous with the pelvis and ureter. The growth has a sharp border line in the ureter about 4 cm. above the surgical incision. Above this the fine papillary growth is seen with velvety surface. This consists of fine tassel-like projections, which float when placed in water. The growth extends upward into the pelvis, but there the uniform fine appearance of the projections is gradually lost. It has rather a warty appearance. The villi are changed into irregularly thickened mushroom-like projections. These are very friable and at places dark, dirty green in appearance; they are covered mostly with necrotic material and blood clot. In the upper portion only a thin wall of fibrotic appearance and measuring 3 mm. in thickness, separates the growth from the surrounding hemorrhagic cavity. This wall shows grossly no suggestion of normal kidney tissue. In the lower portion the growth radiates downward into the tendinous scar tissue. No sharp outlines of it are here seen. There is but a small island measuring about 3 cm. in diameter, which on account of its brown color and soft consistency, seems to be the remnants of the kidney parenchyma.

Microscopical Examination.—Section of the upper portion of the ureter shows the abrupt beginning of a papillary growth (Fig. 2). Up to where the growth begins normal, urogenital epithelial covering is seen. The growth consists almost entirely of fine filiform projections. The stalks of these are covered with a uniform layer of stratified transitional epithelium. The basement membrane of the growth corresponds with that of the normal epithelial lining. This base-line is sharp and straight. There is no epithelial invasion of the stroma at this area. The centres of the stalks contain the blood-vessels and these are surrounded by loose connective tissue. There are ten to twenty-five layers of epithelial cells covering the surface. The cells are mostly cuboidal, and rather regular in shape and size. The basal layer is cylindrical (Fig. 3). There is very slight lymphocytic reaction at the base of the growth. Sections taken higher up from the pelvis of the kidney at different levels show always more and more irregularity of the papillæ as well as of the epithelial cells themselves. The papillary projections are not straight and short, but club-shaped, and have irregular branching. The surface epithelium is irregularly thickened. The epithelial cells are getting more and more irregular in shape and size. There are numerous giant-cells, and especially at the base of the growth very numerous mitotic figures are seen, some of which are also atypical and multipolar. There is a great variety in staining property of the cells, some are very pycnotic, others are pale. There is no sharp line of demarcation, but always more and more invasion of the malignant epithe-

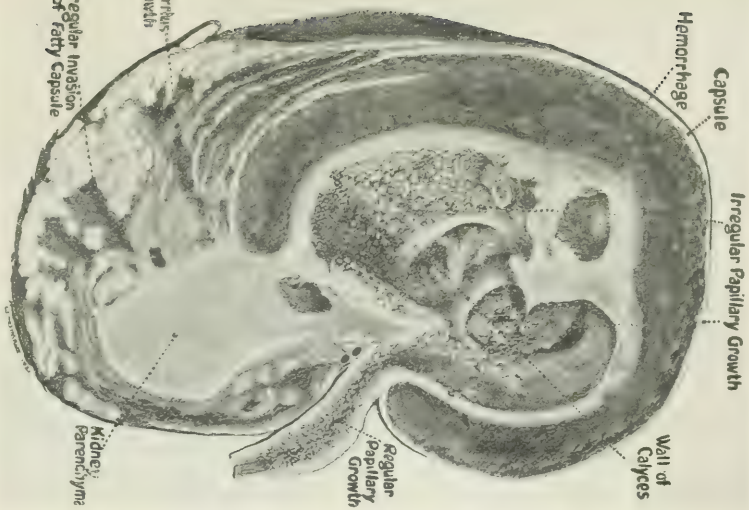


FIG. 1.—(W.P.H. No. 5492) Cross sections of the kidney. The renal parenchyma is mostly destroyed. The pyelonephritic cavity is lined by an irregular papillary growth, which is covered with hemorrhage and necrosis. In the upper portion of the ureter the growth is rather regular. In the lower half scar tissue is seen, containing the scirrhous extension of the growth. Large hemorrhagic cavity is surrounding the upper portion of the kidney. (Natural size.)

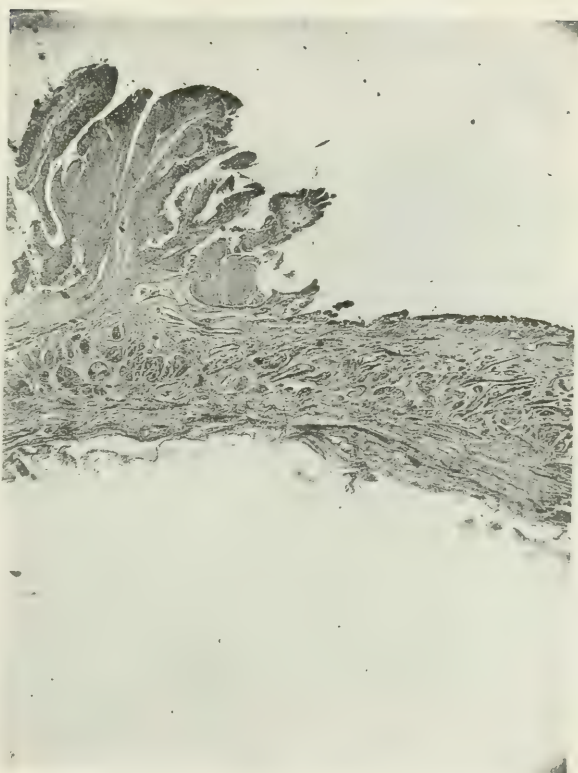


FIG. 2.—The abrupt border of the growth in the ureter showing the typical uroepithelial papilloma, with benign appearance at this place.

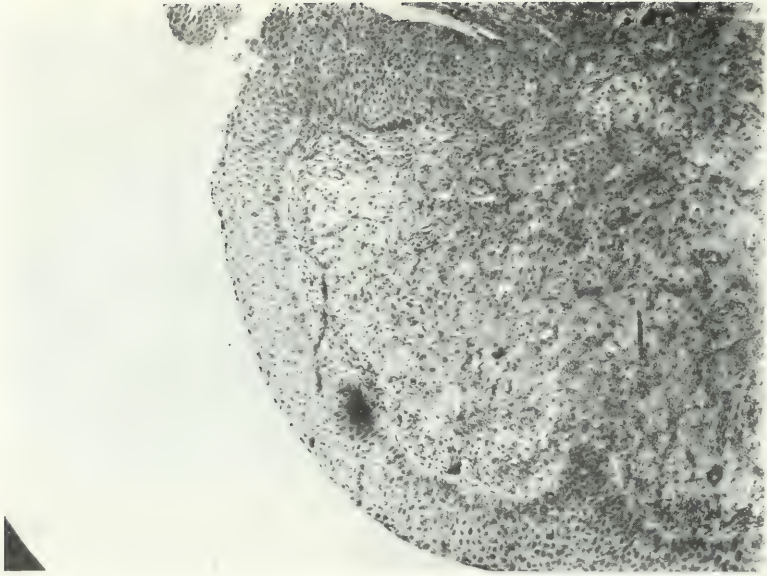


FIG. 3.—The tip of the papillæ seen in Fig. 2.

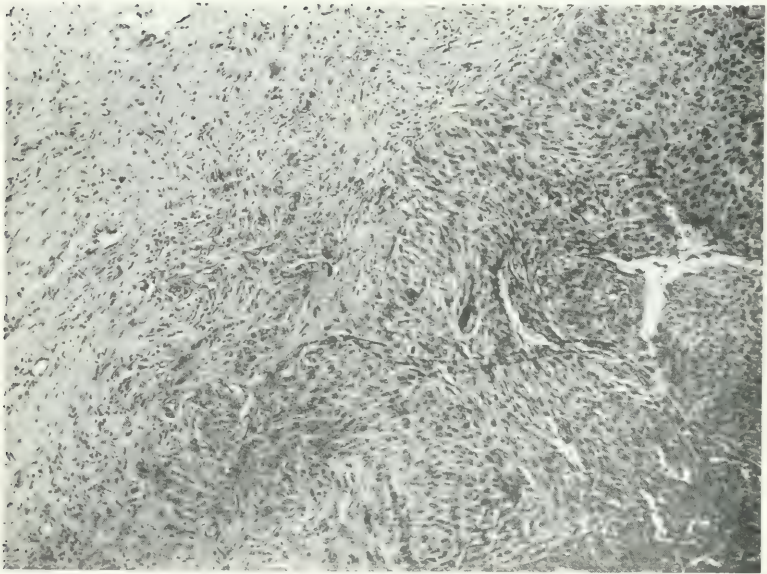


FIG. 4.—The broken-down basement membrane and the irregular medullary growth; section was taken from the wall of the calyx.

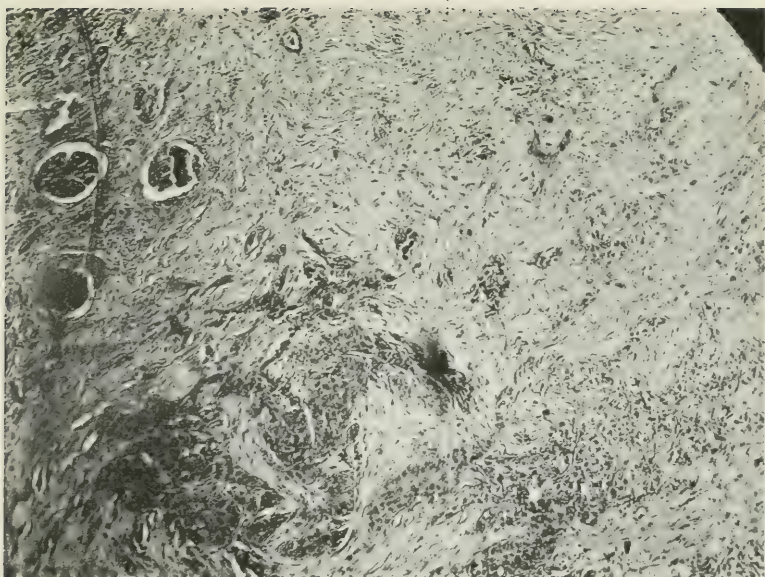


FIG. 5.—The growth with scirrhous character. Dense fibrosis is seen not only surrounding the growth, but also the glomeruli. Section was taken from the scar-like tissue at the lower pole of the kidney.

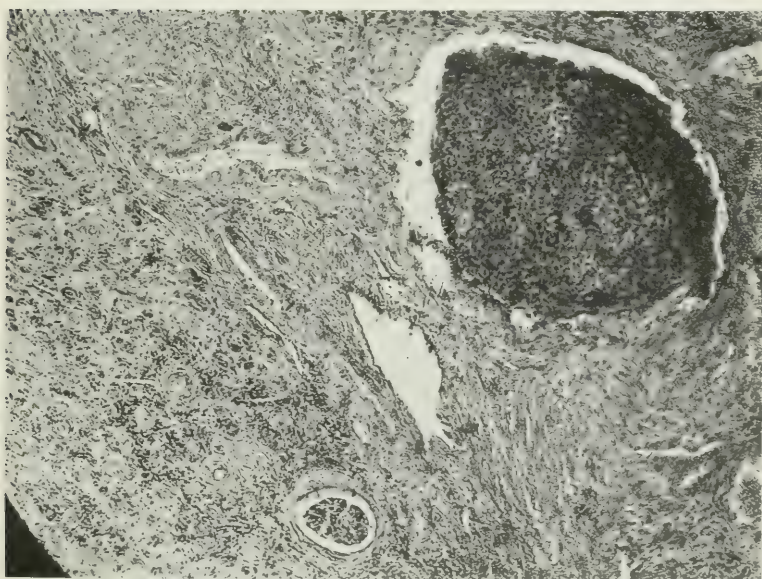


FIG. 6.—The tumor thrombus in a larger vein. Dense fibrosis is surrounding the atrophied tubuli.

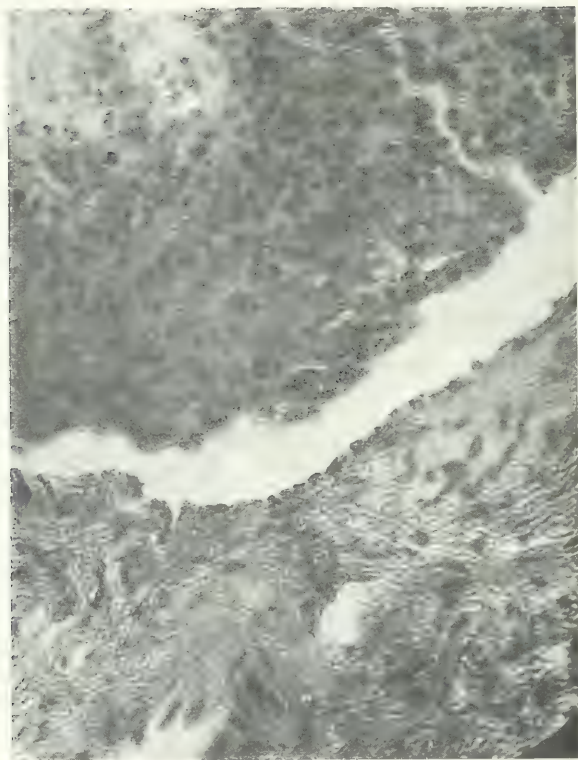


FIG. 7.—High-power magnification of the vessel wall and thrombus



FIG. 8.—Colston's "filling defect" in the pyelogram. A 3-shaped shadow is outlining the large irregular and empty pelvis.

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lium into the kidney tissue (Fig. 4). The epithelial invasion around the border of the pelvis and dilated calyces shows arrangement in solid medullary alveoli. The surrounding stroma contains marked lymphocytic reaction with occasional eosinophile leucocytes. Section taken from the wall separating the growth from the hemorrhagic cavity, shows a very striking picture. On the inner surface papillary projections are seen with extensive surface necrosis and hemorrhage. At the base the malignant nature of the epithelial growth is obvious, on account of the irregular large medullary invasion, through the broken-down basement membranes. The wall itself consists mainly of dense fibrous tissue. Only the irregularly scattered glomeruli will remind one of the origin of the tissue (Figs. 5 and 6). The glomeruli appear sometimes in clumps and show great variety in size. Some are atrophied, small and fibrotic, others are still large with a distinct Bowman capsule. The surrounding tissue shows only dense fibrosis, which is partly hyalinized and contains rich lymphocytic reaction. Narrow strands of small epithelial cells here and there suggest the former tubuli. These are scarce and their lumen, if present, is very narrow, but mostly no lumen is found. The outer surface towards the hemorrhagic cavity is covered with organizing blood clot. The picture of the organization is quite striking. From the surface of the kidney masses of fibroblasts are invading the blood clot. There are also young capillaries and numerous round cells. Sections taken of the lower half of the kidney, which in the gross showed scar-like character, demonstrate clearly the invasive nature of the growth (Fig. 5). There are but small, spiked islands of epithelial cells, which are altogether smaller and darker. The greater portion of the growth is arranged in narrow irregular strands, which branch out irregularly and are compressed and surrounded by dense, partly hyalinized fibrous tissue. This picture, on account of the nature of the cells and characteristic structure, resembles that of a scirrhus carcinoma of the breast to great degree. Section taken from the surface of the lower portions of the cavity shows very extensive necrosis of the surface layers. The small vessels found, show sclerotic changes of their wall with narrowing of the lumen. Some larger veins contain thrombi formed by tumor cells (Figs. 6 and 7). These thrombi are partly necrotic and contain irregular epithelial cells. On the corresponding side the endothelial lining of the vein is destroyed and the thrombus is adherent to the wall of the vessel.

Diagnosis.—Ordinarily three classic symptoms, essential hæmaturia, pain with characteristic radiation, and palpable mass are deemed sufficient in arriving at the diagnosis of kidney tumor.

The essential hæmaturia is unquestionably the most valuable clue, and sometimes is the first symptom to force the patient to consult a physician. This is to be confirmed by cystoscopy, when also the pathological changes of the ureteral orifice are found and the secretion directly obtained can be analyzed from many standpoints. The hæmaturia varies in amount, sometimes it is very scarce and intermittent, or so copious as to lead to the death of the patient (Rayer's case). On the other hand, there are but few cases reported without any hæmaturia (Matsuoka, Neelsen). The hæmaturia may be early or late in the course of disease. In our case the most careful investigation revealed no hæmaturia whatsoever. Not only the questioning of the patient, but careful repeated examination during this observation were futile in this respect. Careful inspection of the gross specimen will give, however, a very plausible explanation for this peculiar feature. Two large hemorrhagic cavities are seen, namely one within and one outside of

the kidney. As seen in Fig. 1 a hemorrhagic cavity of considerable size has separated the capsule from the kidney. Neelsen reported a very similar case without any hæmaturia, but also with just such an extensive "hemorrhagic perinephritis." The hydronephrotic and cystic appearance of the kidney is the evidence of early obstruction leading to complete cessation of kidney secretion. With this anatomical finding the cystoscopic examinations are in good agreement as no secretion was obtained from the corresponding ureter. Hemorrhages did occur perhaps continuously into the central cavity of the growth as well as into the wide cavity surrounding the larger portion of the kidney.

The nature of the pain as usually seen in the kidney tumors shows a uniform picture. There is a dull pain over the corresponding flank. This may be very mild and continuous for a period, then suddenly colicky attacks may occur. These are quite similar to those seen in cases of nephrolithiasis. The colicky pains, when typical, radiate downward to the groin or testicle, apparently in the direction of the ureters. In cases of nephrolithiasis this indicates the passing of stones. In cases of kidney tumor blood clots are passed through increased peristalsis. In our case dull pain in the flanks can be traced for one to two years. It was often so mild, that it amounted to a sensation of fullness and heaviness in the upper left abdomen. The colicky attacks, however, differed greatly from the descriptions usually given in such cases. The best opportunity for observation of this kind was offered at the time of admission. It gave a typical picture of profound shock and was not unlike that seen in cases of internal bleedings with sudden anæmia of the visible mucous membranes, and typical collapse of the patient. At this time the patient had great stabbing pain in the corresponding flank, which, however, did not show any characteristic radiation. The distention and pressure caused by the growth of the tumor had been naturally responsible for the dull pain and sensation of heaviness. As nothing passed down the ureter, the characteristic radiation of the pain was absent. The hemorrhage was the cause of course of the secondary anæmia. This, however, without loss in weight and strength, gave no definite information as to the diagnosis.

The enlargement of the kidney may become palpable in quite an early stage. In his eighty-three cases of adults, Heresco found nineteen times the irregular enlargement the first symptom of renal neoplasm. Albarran calls attention to the fact that this is still more frequent in children. The enlargement is most suggestive when it is irregular, nodular. It may be, however, hidden under the diaphragm, sitting on the upper pole of the kidney, or the enlargement may be uniform, with a smooth surface, as it was in our case.

Albarran in his report of three cases claims to have made a definite diagnosis of pelvic papilloma before operation, differentiating them from the other neoplasms. According to Albarran such criteria of differential diagnosis are: (1) Hæmatonephrosis with excretion of neoplastic cells in

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the urine. "The urine may reveal numerous atypical cells, which are very rare in other renal tumors." (2) Atypical cells directly obtained through the ureter catheter. Absence of pus is, however, required because marked epithelial desquamation may be confusing in cases of various pyelitis. (3) Papillomatous growth at the corresponding ureteral orifice with the other renal symptoms.

As in our case there had been no secretion from the corresponding ureter, Albarran's above criteria did not aid us in the differential diagnosis.

Recent advances in pyelography introduce a valuable aid in the diagnosis of renal protoplasm. "Colston's filling defect" in the pyelogram gives a very characteristic picture. It can be brought out, however, only with careful technic and repeated examinations. After some unsuccessful attempts some pressure had to be applied to force the collargol into the pelvis. The result was striking as Fig. 8 shows; large portions of the pelvis remained empty. Only a 3-shaped shadow indicated the irregular lateral outlines. At the same time these X-ray examinations excluded definitely the existence of stones.

The cystoscopic examination, as Albarran points out, ought to be of great importance, but it failed us completely, as no secretion whatsoever was obtained from the corresponding ureter. The ureteral orifice showed no pathological changes (growth, ulceration, hemorrhage, etc.).

The urine examination of course reflected only the work of the other kidney, and showed every evidence of good function of that side. Seventy-six and eight-tenths per cent. total secretion of phenolsulphonaphthalein for two hours was an indication of good compensating power of that kidney. All these considerations made it possible to arrive at the diagnosis of a kidney enlargement due possibly to hydropyonephrosis or neoplasm, or both affections.

Pathology.—There is very great confusion in the literature in regard to the classification of the neoplasms of the renal pelvis. Essentially there are only two epithelial tumors, both deriving from the urogenital epithelium of the pelvic lining: Benign papilloma and malignant carcinomatous papilloma. When termed malignant, it may still show some of the papillary character and may also show, however, medullary or scirrhous invasion into the surrounding tissue. The surface epithelium of the urogenital tract may undergo metaplasia and change from transitional to squamous epithelium. This in turn may give rise to keratinizing epidermoid carcinoma with pearl formation. Such growth is often also called papillary epithelioma (Kischensky). The various classifications of the investigators are sufficient to show the confusion. Hryntschak, in a study which he based on the collection of sixty-nine cases including his own, classifies pelvic papillomata in three groups: (1) Questionably benign. (2) Unquestionably benign. (3) In transition to malignancy. Albarran and Imbert divide their collection of fifty-four pelvic epithelial tumors also into three classes: (1) Papilloma. (2) Papillary epithelioma. (3) Non-papillary epithelioma. To demonstrate clearly the

confusion, it is interesting also to quote from recent literature. McCown, in his paper "Papillomatous Epithelioma of Kidney Pelvis," reports a case with the following microscopic pathological description. "At no point is the epithelial growth found to break through and invade the kidney substance. The epithelial cells are quite regular in size, shape and arrangement. They are elongated, almost columnar, in shape. They are arranged upright or at right angles to their supporting stroma, in which particular they differ from the arrangement of ordinary squamous epithelium." . . . "There are no areas of necrosis or hemorrhage." In McCown's case there is no keratinization at any point, and the urogenital nature of the growth is still clearly shown everywhere. There is no resemblance at all to epidermal carcinoma and still it is termed epithelioma, although it has also preserved its papillomatous nature throughout without malignant invasion. In the foreign literature De Josselin De Long reports "A case of papillary carcinoma of the renal pelvis," in which he puts particular emphasis on the fact that the growth has not invaded the kidney tissue, but produced secondary atrophy of it by pressure. To call a renal papilloma carcinomatous, it is necessary to find the characteristic malignant features: at least, anaplasia, rapid growth of cells (mitotic figures), definite breaking down of the basement membrane and invasion of surrounding tissues. Metastasis of urogenital papilloma is not frequent; extension, transplantation, and recurrence may, however, occur more commonly. It is interesting to note that in many cases where metastasis occurred the urogenital epithelial cells underwent such considerable malignant changes that its histogenesis was scarcely traceable. Graupner called his two cases "infiltrative carcinoma" of the pelvis because the papillary structure was practically lost and careful investigation was necessary to reveal its origin. In both of his cases extensive metastasis occurred: in lymph-glands, liver, lungs, adrenals, and brain. Kischensky reported a case with extensive metastasis of the metaplastic pelvic epithelioma with marked keratinization.

On the other hand, not all of the papillary growths derive from the renal pelvis; they may take their origin from the kidney parenchyma proper (renal tubuli) and still show a papillary surface. These are papillary adenocarcinomata.

In our case the portions of the growth near the ureter show distinct papillary character (Fig. 2). The surface epithelium covering the projections is here still quite uniform and regular without any invasion. In the calyces, however, where the papillæ have a more wart-like appearance, the tumor cells show not only a great deal of irregularity in size and shape, but very numerous mitotic figures are found, including multipolar shapes, and the invasive character of the growth is most pronounced. Near the ureter the invasion is of medullary nature (Fig. 4). In the more distant places the scirrhotic character of the growth is very striking. Dense fibrous tissue is surrounding the narrow strands of the malignant epithelium. This stroma is partly hyalinized and contains rich lymphocytic reaction. The

fibrosis is not only found surrounding the growth, but also in the remnants of the kidney tissue where very little of the tubular structures are left (Figs. 7 and 8). Necrosis is particularly extensive on the surface of the growth lining the calyces. Very small areas of hemorrhages are found within the growth, but are more extensive over the surfaces. Places of scirrhous growth remind one immediately of breast carcinoma (Fig. 7). Numerous vessels were found containing tumor thrombi. These consist of active and irregular tumor cells, partly adherent to the wall. These cells must have been washed into the blood stream all the time. In spite of this no metastasis has occurred. For the fact, that the distant tissues did not take the graft, the explanation is found in the immunity of various tissues towards the cancer cells. When the capacity of the various resisting tissues to destroy the malignant cells disappears, in other words, when the immunity of the distant tissues is broken down, metastasis will occur. However malignant features the pelvic papilloma may show locally, even invading the blood circulation, it is unable to metastasize for quite a long time (Matsuoka, Hildebrand, etc.). There are two cellular factors that determine the occurrence of metastasis. (1) The degree of malignancy of the cells in the primary growth. (2) The relative immunity of the other tissue cells. A third factor will have to be sought for in the serological changes.

Considering the etiology of pelvic papilloma, Israel concludes from his case that stones play an important rôle in it. Although other cases of this kind are also reported, according to the literature, it is not common to find calculi associated with urinary tumors, especially with bladder papillomata, which again are so frequent. Chronic inflammatory process may often lead, however, to metaplasia, which in turn, with gradual hyperplasia, may result in a growth (Kischensky). Stoerk, in a careful histological study, reported a very interesting case of general papillomatosis of the entire urinary tract following a chronic inflammatory process of the same. Stoerk was the first to point out in this papilloma the importance of the vessel proliferation in the etiology of papilloma. Brutt made a very detailed study of the pathology of the "pyelitis villosa," in which, according to his conception, a rich proliferation of capillaries takes place first. This is characteristic for the regeneration associated with the chronic inflammatory process. Some of the capillaries grow towards the least resistance, perpendicularly upwards to the surface, and when these capillaries are subsequently covered by the epithelium, according to Brutt, the first stage of papilloma formation has taken place.

Beneke and Namba reported a case of carcinomatous papilloma with marked diffuse infiltration in the kidney tissue, which is particularly interesting from the standpoint of etiology. At the first operation this kidney showed a pyelitis, which followed trauma that occurred eight months before. There was no evidence of a growth at this time. A second operation, eleven months after the trauma, revealed a definite kidney tumor. The patient died six weeks after the second operation with generalized metastasis. Micro-

scopical studies of this case showed a medullary carcinoma, originated from the pelvic papilloma. On the other hand, we know that inflammation always initiates stone formation. Therefore it is a mere coincidence to find both stones and tumor in the same case without a causative relation to each other. Israel was the first to attribute primary importance to stones in the etiology of renal papilloma. The malignant invasion is probably responsible for the production of the marked perinephritic reaction in our case. The extensive fibrolipomatosis, especially at the lower end of the kidney, was the result of this inflammatory protective reaction.

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HERNIA OF THE BLADDER*

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THE following case of bladder herniation, complicating an acute intestinal strangulation at the inguinal opening, has served as a stimulus in the preparation of this study of bladder herniæ.

G. T., male, aged seventy-three, laborer. On the morning of January 11, 1921, arose and went to work as usual; about 9 A.M. was suddenly seized with abdominal cramps, soon followed by nausea and vomiting; he was sent to his home and was first seen by me about noon of same day. A cursory examination of the abdomen was made which revealed a rather large irreducible hernial mass in the right inguinal region, which, according to the patient's statement, had existed for more than twenty years and which, during the past four or five years, could never be completely reduced by himself, as had been formerly the case. The diagnosis—that of a strangulated hernia—being self-evident, he was sent at once to the hospital for operation. Owing to his age and the condition which had to be met—for the writer is strongly of the opinion that practically all strangulated herniæ should be operated under local anæsthesia—novocaine infiltration anæsthesia was employed.

The usual hernial incision was made and the underlying tissues cautiously dissected down to the sac, which, on being opened, revealed a coil of small intestine tightly constricted near the deep abdominal ring. Upon release of this constriction, the viability of the gut became apparent and the segment was returned to the abdominal cavity. Attention was next turned to a dissection of the sac and the completion of a radical operation for the cure of the hernia. The dissection was begun from above and carried downward; at this stage of the operation the patient experienced considerable pain from the manipulations necessary to the separation of the large hernial sac, and the scissors were freely used in order to minimize the pain and trauma. The long standing of the hernia and the wearing of an ill-fitting truss had completely obliterated normal anatomical landmarks. Ere the operator was fully aware of what had transpired, a fair-sized cavity had been opened into, from which straw-colored fluid exuded. Further exploration revealed the dome of the bladder below and to the inner side, while a considerable pouch from the bladder—whose walls were markedly thinned out and forming almost a diverticulum—extended some two inches into the inguinal canal and constituted a part of the posterior inner wall of the hernial sac.

This herniated, diverticulum-like portion of the bladder was resected and the vesical opening closed with a double row of chromic catgut

* Read before Southern Surgical Association, December 15, 1921.

sutures. The dissection of the sac was then completed and the Bassini type of closure used to complete the operation. A cigarette drain was inserted through the lower angle of the wound down to the bladder incision; this was removed at the end of forty-eight hours, as no leakage of urine had taken place.

The post-operative behavior of this patient was quite uneventful; the wound healed by first intention throughout and he was discharged from the hospital at the end of two weeks.

Further inquiry into his past history revealed the significant fact that he had had, for several years, much difficulty in voiding, together with increased frequency, more especially by night. The prostate showed a moderate, though not marked, hypertrophy; no cystoscopic studies were made.

When last seen, some three months after the operation, marked improvement had taken place in the vesical symptoms.

Actual hernia of the bladder, while not commonplace, is by no means a surgical curiosity. If one accepts the classification of Brünner and of Eggenberger, of dividing bladder herniæ into two groups, those which are manifest and those which are latent, we have a condition which is by no means rare and one which every surgeon, whose hernial work is at all extensive, has likely encountered more than once.

Karewski made extensive experiments upon the cadaver and demonstrated that there is a close connection between the hernial opening and the bladder coverings in persons of all ages without displacement of the bladder or lipoma and without any abnormalities of the organ. Even slight traction, as in high ligation of the hernial sac, without previous careful dissection of the peritoneum and prevesical fat, may produce a bulging of the bladder wall sufficient to cause this to be incorporated within the grasp of the ligature and subsequent vesical fistula result. This is particularly true in large hernial openings, in old ruptures, in herniæ of the direct type and in recurrence of hernia after operation.

As to the frequency of bladder hernia quite a divergence of opinion exists. Brünner found, in a collection of 1841 operations for various types of hernia, sixteen which were complicated with cystocele, or a little less than one per cent. Eggenberger's statistics show seventy-five cystoceles in 6778 operations, or one and one-tenth per cent. Lucas Championnière reported six in 900 operations, or seven-tenths per cent. Coley, in his large experience, has encountered fourteen cases (1909).

As regards age and sex, Eggenberger's table shows 241 cystoceles, 168 being in the male and seventy-three in the female; no cases of bladder hernia have been observed at the age of puberty. In men, these herniæ occur most frequently between fifty and sixty years of age; in women, between thirty and forty years. Brennisen gives the proportion of male to female cases as

three to one; Eggenberger as three to two, and in Coley's personal experience the ratio has been seven to one.

Of thirty-eight cases of bladder hernia in the female reported by Eggenberger, fifteen were inguinal and twenty-three femoral; of the inguinal, ten were on the right side, four on the left side and one uncertain; of the femoral, ten were on the right side, ten on the left, one double and two uncertain.

Eggenberger states that the majority of bladder herniæ are, in fact, false herniæ, as they either have no peritoneal sac at all, or the bladder is found *alongside* the hernial sac instead of *within* the sac. According, therefore, to the manner in which the peritoneum is involved in these bladder herniæ, he differentiates three varieties, viz.: (a) Extra-peritoneal; (b) para-peritoneal; (c) intra-peritoneal, or true bladder hernia.

Classification (b)—the para-peritoneal type—represents by far the most common variety, and of these he reports seventy-three cases; forty-three external, eight internal inguinal, twenty-one femoral and one perineal. The case reported above falls into this group. In this type of bladder hernia, that portion of the viscus which has peritoneal covering, is continuous with the posterior and inner portion of the true hernial sac; indeed, in some cases, it really forms this portion of the sac, a dissection of which, without injury to the bladder, becoming an exceedingly difficult, if not impossible, task. The important point in such a dilemma is to recognize the presence of the bladder before its penetration and to trim the peritoneal attachments of the sac from this organ.

Of type (c)—the intra-peritoneal or true bladder hernia—Eggenberger was able to find but one case reported in ten years. Brünner's statistics show five such cases.

As regards the genesis of bladder hernia, both Eggenberger and Sonnenberg are inclined to consider pathologic conditions within the bladder and pelvis, such as prostatic hypertrophy, stricture and gravidity, as important contributing factors. Hyperplasia of the fatty layers, because of its frequent prominence in many of the cited cases of vesical hernia, has often been considered as a probable contributing etiologic factor. Monod and Delagenière, as well as Lotheissen, consider this a constant phenomenon in bladder hernia. In fifty per cent. of Eggenberger's reported cases, especial mention is made of an unusually large amount of fat or a lipoma. Yet, the position as to just why this condition, even though a frequent finding at operation, should be viewed as an etiologic factor, has not been logically defended.

The incidence of bladder hernia is much greater in the male than in the female by reason of the fact that the para-peritoneal type is the one most frequently encountered and this type is almost always accompanied by an inguinal hernia to which the male is exceptionally prone. No case of con-

genital bladder hernia has been reported, the youngest case being eighteen months of age.

The preoperative diagnosis of bladder herniation, judging from published statistics, is made with chagrinning infrequency. That the very small, latent and symptomless type should go unrecognized, prior to operation, is not to be wondered at; yet, even at operation, we may often fail in recognition of the true condition. According to Alessandri's table of 223 reported cases, the diagnosis was made eighteen times without being confirmed by operation or post-mortem examination; twenty-five times a vesical hernia was found on autopsy; in but five cases was the condition recognized before operation, in 147 during operation and in the last series, the bladder remained intact in only eleven instances.

Bladder herniæ of even moderate size and duration rarely fail to give rise to vesical symptoms. Sometimes the bladder may be emptied in two stages; in the first, the bladder itself is emptied; in the second, the herniated portion; or, again the urine may be voided in driblets, much like that of the confirmed prostatic. The case herein reported presented, for several years, increased difficulty in completely voiding, as well as a globular mass in the inguinal region which was never completely reducible. These suggestive facts, owing to the urgency of the strangulation, were not ascertained, however, until after the operation. Many, if not actually incarcerated, are not completely reducible, and even after the concomitant intestinal or omental hernia has been reduced, there yet remains a small, slightly oval, doughy tumor. Should the bladder be distended with fluid, the size and shape of this tumor may be made to change and fluctuation elicited. In a suspected case the cystoscope should always be used and the relation of the displacement to the location of the hernia established.

During operation, one or more unusual conditions may present, any one of which should arouse suspicion.

(a) The first and most important is the presence of an unusual amount of extraperitoneal fat in the inguinal canal; this should be liberated and not included in the ligature encircling the neck of the sac. Coley, in his unusually large operative experience, by observing this rule, has never done violence to the bladder.

(b) The hernial opening may be, and usually is, of very large size and out of proportion to the amount of herniated intestine or omentum.

(c) The presenting hernia is most often of the direct type.

(d) Much difficulty may be encountered in separating the hernial sac, more especially the inner posterior portion, from which, if the bladder be involved, free bleeding is likely to ensue.

(e) Identification of the bladder musculature, which, if normal, may readily be done; if thinned out and attenuated as is frequently the case, identification is made difficult and the similarity to that of a hernial sac correspondingly increased.

Bladder herniæ are, as a rule, irreducible; reverting again to Eggenberger's

HERNIA OF THE BLADDER

compiled statistics, we find that out of 110 cases only nineteen were reducible, ten partially reducible, thirty-three irreducible, sixteen incarcerated, and concerning the remaining thirty-two no accurate data are given. Practically all inguinal herniæ of the bladder are associated with either intestinal or omental herniæ, and if the operation is an emergency one for the relief of an acute strangulation and if the herniated bladder be incarcerated, injury to this organ is almost sure to occur. No serious harm should result even though the bladder be wounded, provided the mishap is promptly recognized and properly corrected. The most serious trouble has arisen from unrecognized injury to the smaller bladder herniæ from either the inclusion of the bladder wall within the ligature placed about the sac or else from actual damage done the bladder wall during the sac dissection, without proper repair. Here the mortality has run from thirty to forty per cent.

PRACTICAL DEDUCTIONS

The possibility of bladder involvement should always be suspected and due caution observed:

(a) In all large inguinal herniæ, more especially those of advanced life and in those manifesting prostatic hypertrophy or other signs of crippled bladder function.

(b) In all direct inguinal herniæ, regardless of size or age.

(c) In all operations for recurrence of hernia, for two reasons:

1. Recurrences are notoriously of the direct type.
2. Adhesions and distortions of the neck of the sac from the former operation, resulting in a possible pull on, and displacement of, the bladder.

(d) In all herniæ, presenting an undue amount of fatty tissue closely associated with the sac at or near the fovea inguinalis medialis, the possibility of injury to the bladder is increased and this danger signal should never go unheeded.

GAS CYSTS OF THE INTESTINES

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AND

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Synonyms: This condition is also known as pneumatosis, cystic pneumatosis, pneumatosis, cystoides intestinis hominis, emphysema of the bowel.

Occurrence: That this disease occurs in apparently healthy pigs has been known since the beginning of the nineteenth century, but it was first observed in the human body by Colquet and Duvernay in 1825.¹ Middle-aged males appear to be the most susceptible, although Tuffier² and Letulle³ report a case of a girl twenty-three years of age. Weil⁴ has found reports of only seventy cases of gas cysts of the intestines.

Etiology: Pneumatosis is due to the presence of gas in one or more coats of the intestines. The mechanism of its occurrence is still uncertain and the following theories have been advanced:

1. That the gas is secreted by the process of putrefaction of certain cells. Karsner,⁵ however, states that if this were the case, many bacteria would be demonstrated in the presence of some necrosis. Most authors have been unable to find any bacteria. Koskow⁶ stated that the giant cells show no vacuolization and appear in areas at some distance from the larger cysts. There are no giant cells in the gas glands of the swim bladder of the fish.

2. That the gas is liberated from the tissue lymphatics. There has been no definite proof of this assumption.

3. Bacterial origin: As above stated, bacteria and inflammation with round-cell infiltration are seldom found, although Letulle thinks that organisms from the intestinal tube invade large lymph-channels, causing cysts by gas production.

Nitch⁷ believes that there is an infection of the wall of the cæcum with gas-producing bacilli, notwithstanding the failure to find any organisms in either the cells or exudate. In his case, the histological picture resembled an infectious process which involved the submucosa and the muscularis.

The following bacteria have been found by various authors: *Bacterium coli lymphaticum aerogenes*, *B. aerogenes*, *B. œdematous malignum*, *B. œdematus*, *B. coli*.

4. Neoplastic Theory: Two facts that refute this theory are first, that cysts are not frequently found accompanying cancer, and second, there is a spontaneous disappearance of the cysts followed by cicatrization in most cases.

5. Mechanical Theory: This is the most plausible or, at least, the most

common cause. The mechanism as explained by Karsner is as follows: Pressure, caused by peristaltic action, on a column of gas in the intestines will force the gas through paths of least resistance, *i.e.*, through tissue spaces (especially if there is a break in the lining surface) and through the lymph-channels. Such lesions are frequently very small and therefore are easily overlooked. Tuberculosis, appendicitis, atrophic changes, etc., are causes of these breaks in the intestinal walls. Sudden increase in the intra-intestinal gas pressure may force gas and bacteria through the above defects into the layers of the intestinal wall.

The composition of the gas as analyzed by Tuffier and Letulle is CO₂ 15 per cent., O, 5.6 per cent., H, 73.3 per cent., N, 6.1 per cent. Letulle also stated that the gas is odorless and burns with a blue flame. Nigrisoli⁹ and Grvndhal¹⁰ did not find the gas inflammable. Hey¹¹ states that O₂ plus N₂O were found in one case, CO₂ in three cases and H in one case.

Associated conditions present were: Thirty-two cases had ulcer of the stomach or pylorus; four cases showed tuberculosis of the bowels; two cases complicated tuberculosis of the lungs; two cases complicated appendicitis; two cases complicated chronic enteritis.

Tuberculous peritonitis, pyloric cancer, pernicious anæmia, uræmia, myocardial insufficiency were each concomitant with pneumatosis. Weil's cases had no associated lesion but the patient had had a mild attack of typhoid three years previous.

The case reported below had a definite ulcer at the base of the appendix.

A. F., male, thirty-three years of age, laborer, was first examined by me June 23, 1920. He complained of weakness, general malaise, pain in the right side of the abdomen radiating to the right testicle, and epigastric distress. There was no history of nausea or vomiting, but he was unable to eat much at one time. He had urinary frequency, two or three times at night, unaccompanied by burning or hæmaturia. There was a slight tendency to diarrhœa, and he lost fifteen pounds in four months. There was no history of any venereal disease, cough, night sweats or chills. The patient called attention to a mass in the lower right abdomen. The present complaint dated back three months. The past history was negative except that his tonsils had been removed about one week previous in the hope of relieving him of some vague pains in his joints and to improve his digestion.

Physical examination was negative except for some bad teeth and a slight icterus of the conjunctivæ.

The Wassermann and urinary tests were negative. Temperature and pulse were normal. The blood count showed 9000 W. B. C. and the blood coagulation time was 3.5 minutes.

Abdominal examination showed a sausage-shaped boggy tumor mass in the right lower quadrant of the abdomen, 10 cm. long and about 7.5 cm. wide. This was tender, very freely movable, especially upward toward the costal border. Deep pressure on this mass suggested a fecal impaction. No free fluid was demonstrated. The diagnosis

rested between fecal impaction, incomplete intussusception, tumor of the cæcum, or of the appendix. Unfortunately, no X-ray examinations were made. The patient was operated June 24, 1921. The anæsthetic consisted of N_2O plus O and local infiltration of 1-400 solution of apothecin. A four-inch right rectus incision was made over the mass. Upon opening the peritoneum the tumor was found to consist of a thickened, œdematous, spastic, contracted cæcum and ascending colon. The appendix seemed thickened and the outer gut, from the ileo-cæcal valve to the hepatic flexure, was congested but free from adhesions. The most peculiar condition present was the doughy, crepitant feel of the mass and the appearance of minute, raised, pearly-like gas cysts under the serosa, some of which were discrete and others confluent. Pressure on the bowel caused the air bubbles to change their location very readily.

The operation consisted of the removal of the appendix, cæcum and ascending colon "en masse" with the cautery and in uniting the healthy ileum to the unaffected transverse colon by a lateral enterocolostomy. A small drain was inserted, and removed on the third day following. The patient made an uneventful recovery and left the hospital two weeks after the operation. Two months later he was feeling well, eating regular meals, and had regained his lost weight and strength.

Surgical Pathology: The specimen consisted of the ascending colon and cæcum with the appendix still attached. The mass was boggy and crepitant on palpation. On section the walls of the gut were found to be much thickened and filled with small air-containing cysts. These extended into all coats of the specimen, especially the mucosa and submucosa. The mucosa appeared intact throughout except near the base of the appendix, where there was a small indurated erosion. Pressure on the cæcum caused air bubbles to appear here. The serosa was shiny and numerous air vesicles could be seen throughout it.

Histological Pathology: The section was taken near the ulcer at the base of the appendix. This showed numerous cysts lined by endothelium. There was a marked œdema and a large number of giant cells were seen. Slight increase in fibrous tissue was noted, but nothing was found to indicate that the process was chronic. There was also an absence of pus cells.

The cystic areas extended from the mucosa down to the muscularis and occasionally to the serosa. Many of the cysts were round and adjacent to blood-vessels. In some places the fibrous tissue was spread apart and filled with air. No bacteria were seen in any of the sections studied, neither was there any inflammatory reaction except near the ulcerated area.

The following explanation as to the presence of the gas cysts in the walls of the bowel seemed to be the most plausible: The ulceration seen at the base of the appendix was undoubtedly the portal of entrance for the gas in the submucosa. The mechanical action of the intestinal peristalsis probably accounted for the ascent of the gas up the walls of the gut. The ulcer at the base of the appendix was possibly a

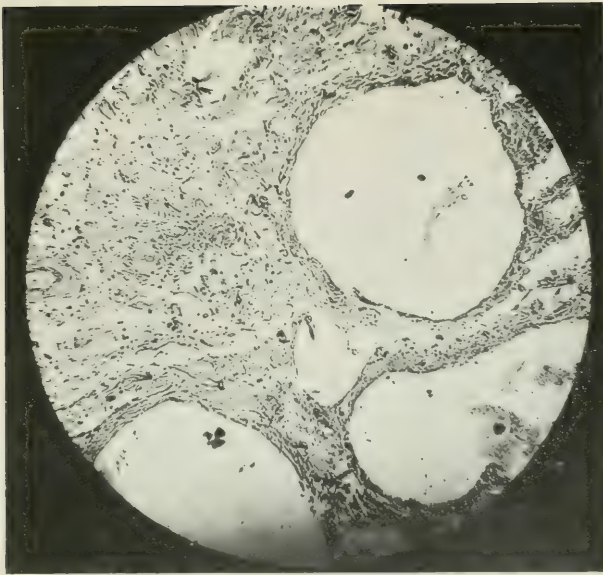


FIG. 1.—Dilated lymphatics forming so-called gas cysts. Completely lined by endothelial cells. Lower power.

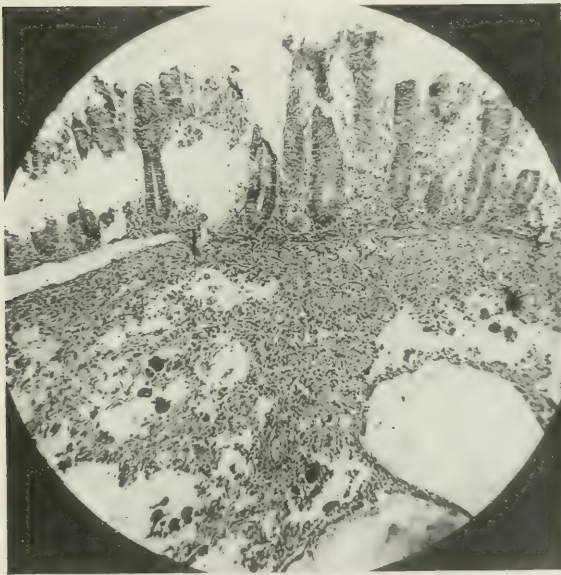


FIG. 2.—Dilated lymphatics giant cells. Lower power.

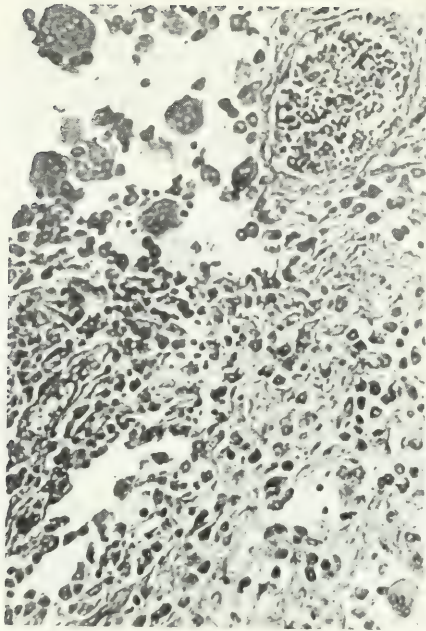


FIG. 3.—Numerous giant cells. High power.

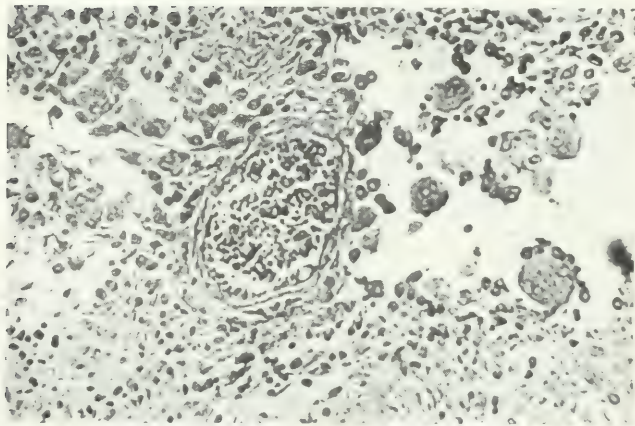


FIG. 4.—Numerous giant cells. High power.

chronic one as there is considerable fibrosis and infiltration of lymphocytes about it. The entrance of the gas was evidently of recent origin, as very little inflammatory reaction to the gas was seen.

Diagnosis: Subacute appendicitis; ulcer at the base of the appendix; gas cysts of the cæcum and ascending colon of mechanical origin.

Pathology of Gas Cysts: Upon opening the peritoneal cavity, the intestines, stomach,¹² gastro-hepatic ligament,¹³ omentum and epiploica may be covered with grayish white, transparent gas cysts varying in size from a pinpoint to the size of a fist.¹⁴ They may be discrete or confluent, pedunculated or sessile, or they may take the form of a bunch of grapes. Some of the cysts may be filled with a purple fluid.¹²

The bowel is thickened, boggy and crepitant to touch like lung tissue or a sponge. There may or may not be some inflammatory reaction present, depending on the cause and the length of time these cysts have been present.

Obstruction of the lumen of the bowel is due to the œdema and swelling of the intestinal coats.

Symptoms: The symptoms of this condition may suggest appendicitis, peritonitis, ileus or a tumor. Notwithstanding extreme distention, the abdomen may be soft and depressible, elastic and resonant to percussion.⁴ Flatulence and recurrent indigestion, pain one or two hours after eating, which is severe at times, and relieved by vomiting, and other symptoms of pyloric or gastric ulcer, such as loss of weight and strength,⁷ may be present. Again, there may be obscure abdominal symptoms referred to the right side, or there may be sudden sharp, colicky pain without vomiting.

Case I by Tuffier and Letulle showed intermittent distention which became permanent, accompanied by vomiting and diarrhœa.

Case II complained of gastric symptoms, abdominal heaviness, change in the shape of the abdomen and frequent vomiting. My patient complained of pains and distress in the abdomen, the inability to eat a full meal, loss of weight and ambition, pain referred from the right sacro-iliac joint to the right testicle, frequent micturition (although urine test were negative), and the presence of the mass in the lower right abdomen. Several weeks after the operation these disturbances disappeared.

Treatment: An exploratory laparotomy is indicated, providing the patient's condition is favorable or when improvement under medical attention warrants it. Weil states that the therapeutic effects of even an exploratory operation are remarkable.

Five writers report the complete disappearance of the cysts after the above operation. Von Hacker advises either puncturing the cysts or leaving them alone. Tuffier made an exploratory operation on his case. The patient died from intestinal obstruction. At autopsy no cysts were found. Kadjan's¹⁵ patient died from recurrence after he had done three laparotomies and excisions. Undoubtedly he did not remove the cause.

Resection or short-circuiting the affected area, with the removal of the possible source, seems to be the most advisable form of treatment, especially in the presence of stenosis of the bowel. This treatment gave the desired result in the case reported above.

CONCLUSION

1. An ulcer at the base of the appendix was undoubtedly the portal through which the gas entered the layers of the cæcum and the ascending colon in the case above reported.

2. Whether or not the infection was secondary to tonsillar infection should be given due consideration.

3. Treatment consists in the removal of the cause if possible, although simple exploratory laparotomies have caused complete cures. Resection or short-circuiting of the afflicted area, with the removal of the primary focus, seems to give best results.

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TRAUMATIC DIAPHRAGMATIC HERNIA

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THE above condition was brought to the attention of surgeons quite forcibly during the late war, as occasionally a missile traversed the left chest and upper abdomen without producing any lesion requiring surgical intervention, save that of a wound of the diaphragm, with resulting diaphragmatic hernia. These cases came to be recognized from the position of the wound being such as might produce this injury, and from the symptoms, which were those of a left-sided pneumothorax, associated with those of a localized peritonitis in the left upper quadrant of the abdomen. The majority of these cases underwent immediate operation, usually with excellent results, but occasionally such a case escaped immediate attention, possibly because the wound of the diaphragm was small and the hernia of the stomach did not develop for some time.

Our first case was a patient aged thirty-two years who had suffered a bullet wound of the chest, in June, 1916, with the entrance at the left ninth rib posteriorly, and the exit at the seventh rib in the mid-axillary line of the same side. After a short stay in the Military Hospital, he was discharged free from symptoms, and remained so until August, 1917, when he commenced to suffer from attacks of severe pain in the epigastrium and at the left costal margin, coming on chiefly after meals. These attacks persisted, becoming more severe, and in 1919, they commenced to be associated with vomiting, which relieved the pain of this attack. Such was his condition when first seen by me in November, 1920. Examination showed the usually accepted signs of a pneumothorax at the left base and the X-ray photograph showed that a large part of the stomach lay above the diaphragm, in other words, he had a diaphragmatic hernia. (Figs. 1 and 2.)

On November 25, 1920, an operation for the radical cure of this was performed, the chest cavity being opened by removing about six inches of the eighth rib, in the posterior-lateral region, cutting the pleura, and then gently separating the adherent lung from the diaphragm and from the hernial sac which had formed, and which was filled by a large portion of the stomach. This sac was opened, and the stomach easily reduced into the abdominal cavity. Then the edges of the tear in the diaphragm, which formed a round hole about 3 inches in diameter were sutured, overlapping as much as possible. The chest wall was then closed in an air-tight manner, and the patient made an uneventful recovery and left the hospital in three weeks, free from all stomach symptoms, remaining so till the present time his diaphragm being intact. (Figs. 3 and 4.)

The second of these cases occurred in civil practice, and was easily recognized from the experience in military surgery.

The patient, a man aged forty-eight years, was admitted to my care in the Royal Victoria Hospital, on September 24, 1921, complaining of severe pain in the epigastrium, which was immediately and greatly increased by swallowing even

a little water. He also had nausea and occasional vomiting, which did not relieve his pain, hiccough, shortness of breath, and pain in the left lower chest on breathing. He stated that about twenty hours previously, he had been struck on the upper part of his abdomen by an angry dehorned bull, and had escaped further injury by the blow knocking him through or over a fence. He immediately commenced to suffer from the above symptoms, which persisted until his entrance to the hospital.

Examination on entrance showed him to have a pulse of about 110, and a respiration rate of about twenty to the minute. There was marked rigidity in the left upper quadrant of the abdomen, with marked immobility of the left lower chest, and in this latter region, there was marked tympany on percussion, with a positive coin sound, both in front and back, up to the level of the fifth rib anteriorly. The apex beat was in the normal place. In other words, the general condition was that of moderate shock, and the local signs and symptoms suggested peritonitis in the left upper quadrant of the abdomen, associated with left-sided pneumothorax. The severe pain on swallowing also suggested stomach involvement; so, in face of an internist's suggestion of interlobar pneumothorax, a diagnosis of diaphragmatic hernia was made, which was later confirmed by X-ray examination. (Figs. 5 and 6.)

On September 25, 1921, under ordinary ether anæsthesia, the thorax was opened by removing the left eighth rib, disclosing a recent tear through the antero-lateral muscle of the diaphragm, about four inches long, with about one-half of the stomach protruding through this rent. There was also considerable free blood in the pleural cavity and an uninjured spleen also presented itself in the wound. The stomach was easily reduced into the peritoneal cavity, and the rent in the diaphragm was sutured, overlapping as much as possible, the effused blood was removed and the chest wall completely closed. The patient made an uneventful recovery and left the hospital in about two months, completely free from symptoms and with the hernia cured. (Figs. 7 and 8.)

Rupture of the diaphragm on the left side by severe blows on the abdomen occurs moderately frequently, and the best results are obtained by early diagnosis and immediate operation. The method of approach for the cure of the same may be through the chest as in the above, or through the abdomen. In the vast majority of cases the cure is much easier through the thoracic route, but I would advise, in future, in similar cases to the above that the incision be on the antero-lateral surface, extending partly into the thoracic cavity and partly into the abdomen, where excision of a rib would not be required, retraction alone being sufficient.

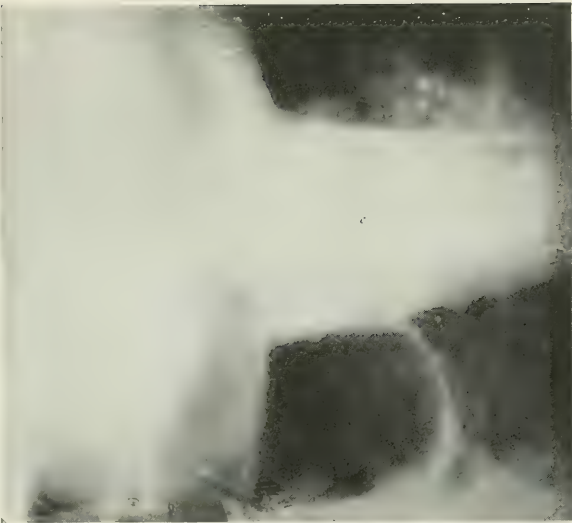


FIG. 1.—X-ray of lower chest with the patient standing, shows level of diaphragm on the right side and on the left side, fluid in the stomach at the same level, with the upper part of the stomach well distended with gas at a much higher level than the diaphragm on the right.



FIG. 2.—X-ray of stomach, after a large barium meal showing a marked constriction of the stomach due to the hernial orifice.

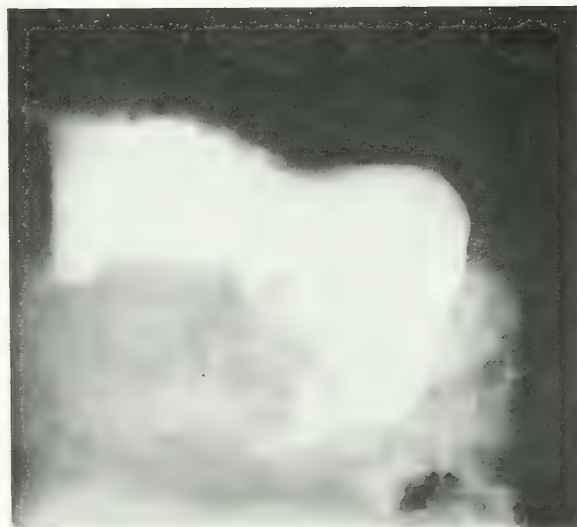


FIG. 3.—Partially filled stomach with fundus adherent to operation wound.

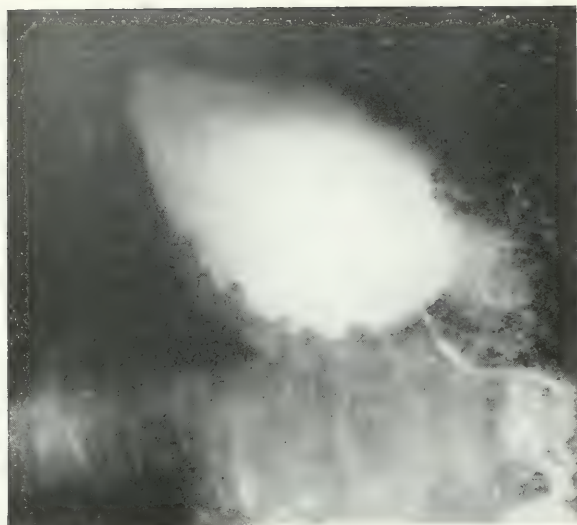


FIG. 4.—Stomach completely filled by barium meal.



FIG. 5.—X-ray of lower chest, with patient sitting erect. Level of diaphragm well shown on right side. On the left the stomach contains a little barium. But the fundus of the stomach, well distended with gas, is seen at a level much higher than that of the right diaphragm.



FIG. 6.—Stomach filled with barium meal, which appears in two parts, the smaller one being above the diaphragm, and the larger one being below.

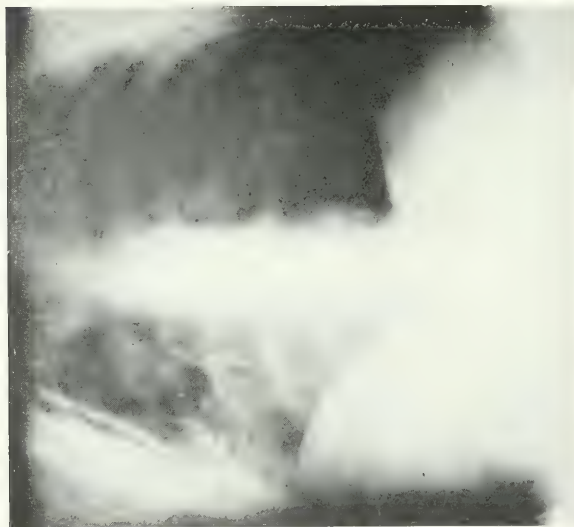


FIG 7.—X-ray showing the healed diaphragm somewhat caught up to the chest wall at the operation wound.

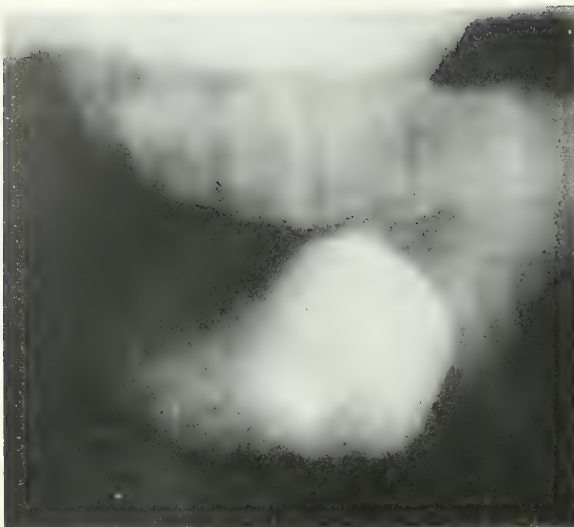


FIG. 8.—X-ray with barium meal showing the level of the diaphragm on the right side and the full stomach on the left, below the diaphragm.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held January 11, 1922

The Vice President, DR. EUGENE H. POOL, in the Chair

STENOSIS OF GASTRO-ENTEROSTOMY STOMA

DR. RICHARD LEWISOHN presented a patient, fifty-three old, who had been operated by Dr. A. A. Berg, at Mount Sinai Hospital, for carcinoma of the pylorus six months previously. The operation consisted in partial gastrectomy and button gastro-enterostomy. The tumor proved to be an adeno-carcinoma.

The patient made an uneventful recovery and gained fifteen pounds in weight following the operation. The button passed a few weeks after the operation.

Four months after the operation the patient had recurrence of symptoms, consisting in nausea, vomiting and loss of weight. X-ray examination showed a very large twenty-four-hour residue in the stomach.

The question that arose was whether the condition was a recurrent carcinoma or was a stenosis of the stoma. A pre-operative diagnosis of stenosis of the stoma was made and the patient operated six weeks ago. The stoma had contracted to the size of a lead-pencil. No ulceration was present. The stoma was entered on its anterior aspect. The posterior wall was left intact and the opening widened to admit two fingers. No sign of any recurrence was found at the time of operation. The vomiting stopped immediately after the operation, the patient has gained in weight, and X-ray examination shows the stomach completely empty after three hours.

DOCTOR LEWISOHN stated that he reported four years ago two cases of stenosis of the stoma following resection of the stomach for carcinoma. Both patients were reoperated upon four months after the primary operation. The recurrent symptoms subsided completely after the secondary operation and the patients lived for nearly two years, after which they succumbed to a recurrent carcinoma. In one case the button was still *in situ*, at the time of the secondary operation. In the other case, as in the case just presented, the button had passed a few weeks after the operation.

No similar cases in which symptoms of recurrent gastric carcinoma were simulated by a stenosis of purely mechanical causes appear to have been reported in the literature. The possibility of a stenosis of the stoma should certainly be considered if patients complain of recurrence of symptoms a few months after resection of the stomach for carcinoma.

DR. HERMANN FISCHER inquired if the Murphy button was used, because, if so, there is a possibility that the button had something to do with the stenosis.

DOCTOR LEWISOHN replied that he felt that the very considerable objection to the Murphy button, which seems to have come into disrepute, was not justified and still used it in the vast majority of his gastric resections. If the button is used the resections can be extended very much farther. Following extensive gastric resections a suture gastro-enterostomy is often very difficult and the choice lies between a button gastro-enterostomy and the Polya-Balfour method of anastomosis. Before closing the gastric end one-half of a Murphy button is dropped into the remnant of the stomach; the other part of the button is inserted into the jejunum in typical fashion. A very small stab is then made into the posterior wall of the stomach. The gastric half of the button is pushed through this opening and stomach and jejunum are thus united. Among all the speaker's gastric resections, stenosis of the stoma occurred in only three cases. In two, the button passed a few weeks after the operation. It is of course possible that the button was the causative factor for the formation of the stenosis.

MUSCULOSPIRAL NERVE REPAIR

DR. ROBERT T. MORRIS presented a young man twenty-five years of age who, on September 24, 1918, caught his arm in a rimming machine and suffered a comminuted fracture of the left humerus. He was operated on immediately at St. Vincent's Hospital, Staten Island.

The patient when seen on November 9, 1918, by the speaker, had a complete musculospiral paralysis. On November 28, Dr. William M. Leszynsky reported that he found some atrophy of the extensor group of muscles of the forearm, wasting quite pronounced circumferentially over the middle portion of the arm, an area of cutaneous hyperæsthesia and incomplete analgesia over the dorsal surface of the thumb and index finger corresponding to the distribution of the radial branch of the musculospiral nerve. He found a paralysis of the muscles supplied by the musculospiral nerve and voluntary movements restricted to the biceps group and deltoid muscles. Radiographs taken eight weeks after the injury showed both transverse and longitudinal comminution of the shaft of the humerus.

On December 12, 1918, operation at Broad Street Hospital; excision of the large hand scar and exposure of the injured nerve area. The various fractures appeared to be progressing toward fibrous union. The musculospiral nerve was found to be practically absent for a distance of more than three inches; some crushed nerve elements remained mixed with scar tissue over this area. At the proximal end of the wound the musculospiral trunk appeared to be normal and at the distal end of the wound the branches of the musculospiral appeared to be undergoing degenerative change. Little if any nerve tissue could be recognized between these proximal and distal points. The nerve ends were bridged with silk thread for a distance of at least three inches following traces of some sheath. The freed trunk above was buried

HEPATIC JEJUNAL ANASTOMOSIS

beneath a muscle flap of the deltoid. Primary union followed. The arm was placed in splints and later carried in a device developed by the patient.

No notable change took place until some sixteen months after the operation. At that time the patient while using his arm as a weight for holding woodwork which he was sawing began to feel a return of strength and of sensation in the injured arm. He has recently appeared at the office stating that his left arm is practically as good as his right, with complete return of musculospiral and other functions. He states that the only difference which he notes is that his left arm tires a little more quickly than the right arm.

HEPATIC JEJUNAL ANASTOMOSIS FOR DESTRUCTION OF COMMON DUCT

DR. CHARLES L. GIBSON presented a patient thirty-five years old, who entered the New York Hospital, April 11, 1919, for relief of swelling below right costal margin of two weeks' duration. She has suffered from rather indefinite digestive disturbance for past two years. Otherwise, history is negative.

Examination shows mass, size of hen's egg, in right hypochondrium. Skin not involved. Mass seems to be situated in the abdominal wall. Somewhat tender to pressure.

Operation, April 12, 1919. Four-inch incision outside rectus muscle, opening into an abscess which leads into an old, adherent gall-bladder containing two calculi. Wound drained with rubber dam Mikulicz tampon.

Discharged from hospital two weeks later with a sinus discharging muco-pus. In that time several more gall-stones had been removed. To return for radical operation.

On October 11, 1919, laparotomy performed outside of right rectus, encircling gall-bladder sinus. Gall-bladder hardly recognizable owing to marked changes and anatomy of the ducts obscure. It was found on dissection that the upper layer or roof of the first part of the common duct up to its junction with the hepatic had either been stripped off or destroyed. Gall-bladder removed and operation to be described performed, preference being given to it rather than the other possibilities of drainage with the tube coming out into the duodenum or a "T" tube to be removed later, or an implantation into the stomach or duodenum. These were rejected because, while the primary results are often seemingly brilliant, the end results are for the most part very unsatisfactory owing to late cicatricial changes.

The hepatic duct, which was a little dilated, was divided at its junction with the common duct and a side-to-end anastomosis made with the upper portion of the jejunum which was loosely brought up over the colon. There was no special difficulty in performing this anastomosis. A precautionary drain of rubber dam was inserted to site of anastomosis.

The operation was well borne. Convalescence was satisfactory,

patient being discharged in nineteen days. There was never any jaundice or any other disturbance.

Since leaving the hospital patient has been under observation and has made a marked gain in general health with entire relief of all former symptoms. She has also gained much weight.

DR. EUGENE H. POOL said that the two features which cause embarrassment in an operation for reconstruction of the bile duct are, first, the difficulty of finding the duct; second, what to do when it is found. The first difficulty can be avoided by lifting the anterior edge of the liver and following the inferior surface downward which leads one to the dilated sac or biliary reservoir, which is always present above the obstruction. Through an opening in this dilated hepatic duct a probe may be passed down, demonstrating where the stenosis is; dissecting along the probe readily exposes the stenosed portion and the duct lower down.

In a recent case Doctor Pool found a stricture one-quarter inch long just below the hepatic ducts. The case had been operated twice by another surgeon. Anastomosis to the stomach was decided upon and carried out by the following method. A probe was passed into the stomach through its anterior wall three inches from the pylorus and out the anterior wall near the lesser curvature close to the pylorus. The duct was cut across at the stricture and the stump of the duct was sutured to mucous membrane at the opening in the stomach. One end of a rubber tube was introduced into the reservoir of bile and fixed with suture. The other end of tube was then attached to probe and pulled through the stomach and out through the anterior wall. As the tube was drawn upon, the stomach was inverted with purse-string sutures over tube and the stump of duct, thus forming a tight gastro-biliary fistula. Some excess of tube was left in stomach so as not to be pulled upon when stomach dilated. The other gastric opening was inverted with purse strings. The idea in not making an opening in the portion of tube which passed through stomach was to prevent bile from immediately entering stomach and also to recognize if tube became obstructed. Unfortunately, there was also present a duodenal ulcer which was inverted apparently without causing obstruction. The tube was removed on the ninth day, up to which time the bile drainage was adequate and the patient's condition good.

Since reporting this case, Doctor Pool announces patient died as result of pyloric obstruction. As there was no autopsy, it is not known whether the anastomosis or operation for the duodenal ulcer was responsible.

PLASTIC ON HAND

DOCTOR GIBSON also presented a patient, thirty-three years old, who was admitted to the New York Hospital, January 8, 1920, having injured his hand in a driving wheel. Palmar flap of skin and subcutaneous tissue and dorsal flap torn up from hand but attached to hand at base of fingers. Two small pieces of skin on the ulnar side of hand were missing

TUMORS OF THE BREAST-BENIGN AND MALIGNANT

and a small piece of skin on radial side. Tendons and bones were intact.

On January 8, under ether anæsthesia, the flaps were lifted up and cleaned as far as possible. Several small vessels tied. Carrel tubes inserted. Hand put on splint.

Observations showed the flaps were not viable and they were eventually trimmed off.

On January 28, there being a good bed of firm granulations, under an anæsthetic the whole area was grafted with Thiersch grafts.

Discharged on February 9 with a good part of the wound closed by Thiersch grafts but some granulating area still remained, especially on the ulnar aspect.

Reëntered May 21, 1920. Meanwhile had been treated by baking and massage, getting fairly good function in all but little finger. A persistent cicatricial band prevented flexion at metacarpophalangeal joint.

On May 22, under ether anæsthesia, the defective cicatrix on the ulnar aspect, which bound down the little finger, was excised. The extensor tendons were liberated, allowing of flexion after forcible manipulation of the metacarpophalangeal joint. To prevent the return of the cicatricial condition, a flap was raised from the central portion of the abdomen and its free edge sewn to the upper free edge of loss of tissue on ulnar side of the hand.

Part of this flap was cut away under local anæsthesia on June 2.

The remainder of the flap was cut away on June 8 under ether anæsthesia. It bled freely. Deep surface of tendons exposed and fat inserted. The metacarpophalangeal joint was again forcibly flexed. Suture of flap to remaining surface of hand.

Discharged on June 18. Wound has healed well and there was already some improvement in function of little finger.

On September 27, 1920, considerable improvement in function of hand but still limitation at metacarpophalangeal joint. Attempt to mobilize this under gas gave no result.

March 21, 1921. All functions of hand are established except motion of metacarpophalangeal joint of little finger. Phalanx evidently dislocated into palm, not allowing little finger to close. Offered to resect joint but patient did not wish to lay up. He has now entirely resumed his former occupation.

TUMORS OF THE BREAST, BENIGN AND MALIGNANT

DR. CHARLES H. PECK and DR. W. C. WHITE (by invitation) read a paper with the above title.

In discussing this paper Dr. Charles N. Dowd referred to the increased proportion of the known malignant tumors of the breast which come to the attention of a surgeon. General instruction in the cancer problem had brought the subject more prominently before the public and many patients now consult the surgeon for these conditions who previously would not have done so. Without doubt the cases who really have malignant growths are coming for treatment earlier than formerly.

One form of benign swelling is worthy of increased attention, and one does not often see reference to it in the literature. This is the simple pyogenic

inflammation in a non-lactating breast, usually forming about some ducts which have apparently been clogged. These abscesses are not common but they nevertheless are seen in sufficient number to be a definite factor.

In these days when there is so marked a tendency to turn to other forms of treatment for cancer, it is well to again emphasize the results which are obtained by routine operation. A cure may be expected in from twenty-five to fifty per cent. of the cases as they come to the surgeon at the present time; this is a better percentage of cure, in all probability, than can be obtained by any other method. This estimate is based on five years of post-operative observation. There seems to be a need at the present time of keeping before the public mind the fact that surgery offers more than any other form of treatment for these patients.

DR. ALLEN O. WHIPPLE asked Doctor Peck what his views were regarding radium or X-ray therapy before and after the radical operation in these cases of breast tumor.

DR. ALEXIS V. MOSCHCOWITZ remarked that in his personal experience he had never seen a benign tumor of the breast degenerate into a malignant one. He did not deny its possibility, however. The text-books lay considerable stress upon this point and frequently advise a more radical procedure than he was accustomed to do. He was inclined to believe that this view was needlessly exaggerated. He had not found that a bloody discharge from the nipple was a sign of malignancy. On the contrary, it has been his experience that such bleeding was usually caused by a small, perfectly benign papilloma in one of the major excretory ducts of the breast. The extirpation of this duct with local excision of that part of the breast drained by it usually sufficed for a cure.

He felt that occasionally surgeons went too far with the extirpation of the cutaneous covering of the breast. This opinion being based upon the fact that up to four months ago, when the speaker saw two such cases, he never experienced a local cutaneous recurrence, nor for that matter any local recurrence, and certainly never in those cases in which he was satisfied at the termination of the operation that the procedure had been truly radical. This, of course, did not exclude distant metastases, for he looked upon these, without any local recurrence, as proof of the fact that these metastases were already present in an undiscoverable stage at the time of the operation.

He had been accustomed for about fifteen years to dress cases of breast amputation with the arm abducted at a right angle. The patients were very uncomfortable for the first four or five days, *i.e.*, until the first dressing, but since he had begun doing this he had never seen the rather distressing lymph-œdema of the arm, and had found that the patient regained function of the arm very promptly.

DR. EDWIN BEER considered that among the very interesting points brought out by Doctor Peck's paper, there was one which seemed of very great importance as exemplified by the series of eleven cases in which a primary incision was made into the breast tumor for diagnosis, and days

and even weeks elapsed before the secondary or radical operation. The fact that a number of these cases were cured by the secondary operation was, in a measure, an unfortunate result, because, contrary to the experience of others in which delayed radical operation had not led to a cure, Doctor Peck's series might lead surgeons in the future to delay the second or radical operation until they obtain a definite pathological diagnosis of carcinoma from the specimen removed at the first operation. This would surely be unfortunate in view of the general experience that delay in doing the radical operation so regularly diminishes the patient's chance of a permanent cure. The proper procedure would be to let a radical operation immediately follow the diagnostic exploratory incision.

DR. BURTON J. LEE commented on the comparative frequency, according to Doctor Peck's paper, of the occurrence of carcinoma in non-lactating breasts. In the cases of breast cancer at the Memorial Hospital the speaker had found that approximately one-third of the patients had non-lactating breasts. This fact suggested to him the possibility that carcinoma of the breast may be in some way associated with an interference with normal development of the mammary gland.

As to the question of operability or inoperability, Doctor Lee wanted to know what the feeling was in the society with regard to the proper treatment of a case of breast cancer in the presence of involved supraclavicular nodes. He himself had felt that definite involvement of these nodes should be sufficient to place the case in the inoperable class, and he therefore withheld operation in these cases, relying upon radiation alone.

Having seen a considerable number of Doctor Peck's cases which were referred to the breast clinic at the Memorial Hospital for post-operative radiation, Doctor Lee had been impressed with the excellent arm function obtained.

DR. FRANK S. MATHEWS said that his personal experience had led him to think that carcinoma was more likely to affect breasts that have been the seat of diseases of benign type. He rarely resorts to skin graft but, following the work of Sampson Handley, had practiced extensive subcutaneous dissection. Looking over the records of his own cases recently he found the percentage of apparent cures about the same as those reported by Doctor Peck. Referring to the previous discussion regarding the dangers of removing a nodule for examination preliminary to complete operation, the speaker liked to avoid this method when possible. In one of his own cases, however, a doctor had made a local incision and removed a cancerous nodule and had gone through the cancer tissue. Doctor Mathews operated a month later and the patient lived five years and died of an acute abdominal illness. He found it advantageous always to remove the pectoral muscle and dissect the axilla from above downward.

DR. GEORGE H. SEMKEN noted that recurrences appeared in remote tissues or in the neighborhood of the field of operation. Of the remote recurrences, many are probably the result of the handling of the primary

tumor, either by the patient or by various physicians. Tyzzer has shown in mice how much earlier and more frequently metastases appear when the tumors have been handled than when they have been left undisturbed. The examination of such patients, therefore, becomes a matter of great importance. If the patient lies supine, so that the breast flattens out upon the chest wall, it is possible to detect gross lesions by light pressure of the flat hand upon the breast against the rigid chest wall, and gentle palpation will then determine the necessary data concerning size, shape, consistency, etc. If no gross lesion is found, a light movement of the finger tips over the breast, from periphery to nipple, may disclose the smaller lesions.

The regional recurrences in cases that seemed favorable at the time of the primary operation, seem often to be due to faulty surgical procedures. The desire to avoid disfigurement may lead to unwise conservatism in the extent of the incision, and in the amount of skin removed. The desire to obtain an ideal healing may influence the operator to dissect the skin flaps very thick so that they will not be likely to become necrotic at the margins because of lack of vascular supply. The desire to shorten the duration of the operation may result in a hurried and incomplete dissection of the axilla. Any of these factors may lead to failure of cure; and it must be noted, with regret, that many cases show cancer recurrences in tissues that should have been removed at the primary operation.

With the present unsatisfactory percentage of cures the radical breast operation presents a serious responsibility to the surgeon. Conservatism is ill advised; rather, the limits of the operation and the time given to its performance should be extended. The long Meyer-Halsted incision gives free access, and there will be no axillary contracture if the axillary crossing is made at a level one-third of the distance from the pectoral fold to the clavicle. A Thiersch skin graft is not objectionable, and is best done as a primary procedure when it is required. In the dissection of the axillary fat and lymphatic structures, the principle of the unbroken envelope necessitates the removal of anterior and posterior fasciæ intact. Since so many recurrent cases show firm fixation of the cancerous nodes to the sheath of the axillary vein, it seems desirable to remove the anterior and internal portion of the vein sheath at the primary operation, as a part of the lymphatic envelope. For similar reasons, and for obtaining better access to the axilla, it is desirable to remove the pectoral muscles completely.

With reference to the incision of the breast tumors for diagnosis before operation, either for frozen sections or for later reports, one cannot emphasize too strongly the un wisdom of this procedure as a routine measure. With care, patience, and good judgment, the usual means of examination will lead to but few mistakes in diagnosis. Among the breast conditions that resemble cancer clinically, perhaps the closest simulant is a tuberculosis that has not yet broken through to form sinuses.

DR. JOSEPH WIENER expressed his preference for the Stewart incision which he has used for five years. For twenty years he used the Halsted, but

had discarded it. With the Stewart incision there is less œdema of the arm, and it has numerous advantages over the Halsted incision where the tumor does not lie too high.

As regards late recurrences, Doctor Wiener had a patient from whom twenty-one years ago he removed the right breast. Ten years afterward she had a recurrence and he removed the opposite breast. She has now been free from recurrence for ten years.

As to lymphœdema, early passive motion seems to limit this. The arm is kept against the chest for six days and after that it is mobilized.

He has been giving Coolidge treatments in every case of carcinoma of the breast for the past six years. In following these cases up he has noted a few striking results. One case developed extensive metastasis in the sternum, a growth as large as a fist, which disappeared under Coolidge treatment, but some months later a cerebral metastasis occurred. Great aid can be given with it. Some women are alive and well to-day as a result of it who would otherwise probably have died of metastases.

DR. CLARENCE A. MCWILLIAMS said that in 1900 he published (*Medical News*, April 28th) an analysis of 100 cases of cancer of the breast which had been operated upon in the Presbyterian Hospital. Since that time the technic of the operation has changed but little, but the patients are coming now much earlier for operation. Thus, the axillary glands were palpable in 48.9 per cent. of the cases while after operation the glands were found cancerous by the microscope in seventy-eight and six-tenths per cent. of the patients. Thirty-four per cent. showed no recurrence at the end of three years. Recurrence took place locally in fifteen cases. The average length of time from the period of recurrence to death was five months. It would seem that little change can be made in the thoroughness of the operation for cancer of the breast, and the future improvement would seem to lie in getting the patients earlier and to supplement the operation by treatments with radium and the X-rays.

DR. RICHARD LEWISOHN expressed his belief that a pathologist should be present at every operation for tumor of the breast. No radical amputation of the breast ought to be performed without previous inspection of the tumor. He was surprised to hear Doctor Semken state that radical amputation should be performed without exploration of the tumor. The question of malignancy cannot be definitely settled by palpation in many cases. Tumors which appear to be malignant on palpation often prove to be inflammatory on section. In order to avoid unnecessary amputations of the breast, careful macroscopical and, if necessary, microscopical inspection of the tumor is certainly indicated.

DR. WILLIAM CRAWFORD WHITE had hoped that the discussion would bring out some opinions as to the wisdom of local excision in localized cystic mastitis. He had followed that procedure for some years with satisfactory results.

This series of Doctor Peck had been worked up without reference to radium or X-ray and it will be interesting to note the results after their use.

DR. CHARLES H. PECK, in closing the discussion, commented first on the remarks as to the practice of excising the tumor and delaying the radical operation to await the pathological diagnosis; he did not advise this procedure. He simply looked up these cases in which, for one reason or another, radical operation was not done at once, eleven in all, and was surprised to find five were well. Another point he wished to emphasize was that he did not cut into the tumor; he excised it with a safe margin of breast tissue, and it was then cut, outside the body, by the pathologist. He got what information he could by the gross appearance and, if at all in doubt, had a frozen section made at once. This was his routine procedure, and he believed, the best practice.

Perhaps he had stated results a little imperfectly. He followed 118 cases in the malignant group and lost track of seventy-seven. Six of these died in the hospital following operation. The custom has been to operate upon any case that offers the likelihood of even temporary relief and not to refuse cases so advanced as to offer no hope of radical cure. Of the 112 cases followed, which recovered, fifty-three are well and free from recurrence at the present time and twenty-six of these are well more than five years. Eleven out of the twenty-six had axillary metastases at the time of operation.

In regard to the question of supraclavicular node dissection, he had never done that, but confessed that he had seen quite a few cases where the first recurrence was in the supraclavicular nodes. If recurrence had come there it has been dealt with either by X-ray or radium treatment or by secondary operation.

The transverse incision had been selected almost exclusively for the past six or seven years. It is an adequate incision, giving good exposure, and it permits the removal of a large area of skin without the necessity of grafting. Excision of the rectus sheath had not been made a part of the routine technic, but was often done. Diffusion of the disease in all directions is a tendency in carcinoma, as pointed out by Handley, especially in the subcutaneous tissue and lymphatics, and it is important to remove as wide an area of this tissue as possible by the oblique dissection beneath the skin flaps, which he advocates.

As to how long it is safe to wait in recently discovered lumps, having the characteristics of a chronic mastitis, it is difficult to say. Some such masses will disappear completely in from three to six weeks. If they fail to disappear in that time, removal is the safer course to follow.

CARCINOMA OF TRANSVERSE COLON, RESECTED UNDER LOCAL ANÆSTHESIA

DR. JOSEPH WIENER presented a specimen with the following report: E. S., seventy-two years old, first seen October 15, 1921. Ten years before he had had icterus for several months. Nine months before he had begun to have severe right iliac pain. At the start the attacks of pain came on every two to four weeks, lasting several days. During the attacks of pain he was constipated. The pains gradually increased in frequency until they were present almost constantly. Con-

stipation became more and more marked and was not much improved by cathartics. No blood was ever noticed in the stools. He lost eighteen pounds in eight months and weighed ninety-eight pounds. He had lost a great deal of sleep and felt very weak. He had had an intermittent diabetes for four years without acidosis. During the preceding six months there had been some abdominal distention with nausea, but no vomiting. Radiographs taken nine months before had been negative.

On examination there was general abdominal tenderness. The transverse colon was filled with hard fæces. On deep pressure there was apparently an indefinite mass in the right iliac fossa. Rectal examination revealed a small, hard prostate. Hæmoglobin, fifty-two per cent. The clinical diagnosis was carcinoma of the cæcum with subacute intestinal obstruction. For six days he was given cathartics and enemata until the bowels were thoroughly cleaned out. His digestion was so poor that he could only take small quantities of soft food, and he lost a few pounds more before it was thought safe to open the abdomen. He was given ten minims of tincture of opium an hour before operation. Under apothesine and adrenaline anæsthesia the abdomen was opened through a right upper rectus incision. A large constricting tumor was found in the middle of the transverse colon which was freely movable. There was only one enlarged gland in the mesocolon. An exclusion operation was decided upon as the first step to a subsequent resection of the colon. The hepatic flexure was divided between two rows of linen sutures. The proximal end was closed with two additional layers of linen sutures. A side-to-side anastomosis between the closed proximal end and the descending colon just below the splenic flexure was done, using clamps and Connell linen sutures, as for a gastro-enterostomy.

The transverse colon, together with the mesocolon and the enlarged gland, was then removed and the splenic flexure closed with three layers of linen sutures. The liver appeared normal; the colon proximal to the tumor was very hypertrophic.

The entire operation took two and a quarter hours and the most meticulous care was taken to control even the smallest vessels on account of the poor general condition. At no time during the operation did the man complain of pain, and the pulse was not over seventy.

Immediately after operation he took small amounts of coffee and whisky by mouth. On the second day he passed gas freely, but he gradually became weaker; forty-eight hours after operation he was given 700 c.c. of blood by the syringe method. Twelve hours later he went into coma which lasted eight hours. Under active stimulation he came out of the coma completely. He never vomited after operation and retained whatever nourishment he took. He gradually grew weaker and seemed to lose weight daily, although he weighed only ninety-eight pounds at the time of admission, and probably a few pounds less at the time of operation. The skin sutures were removed on the fourth day. Death took place five days after operation. No autopsy obtained.

Of the more than 400 operations that the speaker had done under local anæsthesia, this case represented the longest and most extensive. At no time during the operation did the patient complain of pain, and at no time was he restless. It was thought that if the operation had been done a few months earlier an operative recovery would have been obtained.

CORRESPONDENCE

OSTEOPHYTIC ANKYLOSIS OF ELBOW

EDITOR ANNALS OF SURGERY:

SIR:

I forward to you this case report of a condition entirely novel to me, of special note, as showing how extensive a result may follow a slight injury.

The patient, Miss T. T., age fifteen, while running, fell to the ground, and as a result of the fall injured her left elbow. This occurred about November, 1920. Her doctor made a diagnosis of fracture and treated it as such, a perfectly correct treatment. When the splints were removed there was found to be limited motion in the joint. This was treated by massage and passive motion for a period of two or three months. There being no improvement, rather less motion, the patient was referred to my Clinic at St. Joseph's Mercy Hospital. When an X-ray picture was taken a condition was found as revealed in the picture of that date (March 12, 1921) (Fig. 1). It will be seen that there was an arch of bone grown across the joint anteriorly from the humerus to the ulna, producing almost complete ankylosis at an angle half-way between full extension and a right angle. However, the patient wished to try massage and passive motion for a time longer. She was not seen again until June 15, 1921. The condition being unchanged July 23, 1921, the patient came for operation. The operation consisted in chiseling out the arch of bone which produced the ankylosis, the result being as shown in the picture taken immediately afterwards (Fig. 2). Motion was immediately restored and two months after the operation motion in the elbow is almost normal, the X-ray picture taken at that time showing no recurrence of the bony arch. At the present time the young lady has almost normal motion and the full use of her arm.

GEORGE KESSEL, M.D.,
Surgeon-in-Chief.

St. Joseph's Mercy Hospital,
Cresco, Iowa.

UMBILICAL AND INGUINO-LABIAL HERNIA IN WOMAN OF ADVANCED AGE

EDITOR OF ANNALS OF SURGERY:

SIR:

I offer the report of the following case because the conditions are comparatively rare in women of advanced age, and second, because this woman was a drug addict. In order to arouse sympathy she would display her physical infirmities to the casual passer-by on the street so that she might obtain money to purchase her desired narcotic. She was a negro woman, age of seventy-nine years. She became a public nuisance and the police brought her to the hospital for treatment. The



FIG. 1.—Osteophyte producing ankylosis of elbow.

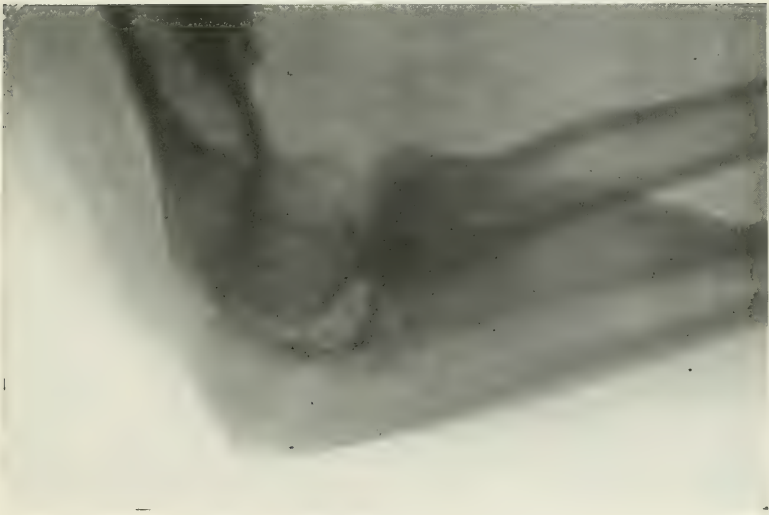


FIG. 2.—Osteophyte removed freeing joint.



FIG. 3.—Umbilical and inguino-labial hernia.

surface of her skin, especially on the arms and chest, presented numerous elevations, the result of self-administered hypodermic injections. The abdomen presented two distinct hernia protrusions, one to the right of and involving the umbilicus, the other in the lower inguinal region (Fig. 3). The umbilical hernia was reducible but was the seat of much pain, whereas the inguinal hernia was irreducible but not very painful, but its bulk interfered greatly in walking.

The inguinal protrusion had a circumference of five inches; was twelve inches long and involved the right labia majora.

The umbilical hernia was operated upon first, after the Mayo method. The omentum was found densely adherent to the peritoneum, which condition was the cause of her pain.

One month later the inguinal hernia was operated upon. The incision was made from the midpoint of the base of the tumor to the end of the same and the whole mass was dissected to the peritoneal sac. Within the sac was omentum and coils of intestines—both were closely adherent to the sac and were detached with difficulty. All the raw surfaces on the intestines were whipped over with fine catgut suture. All raw surfaces were covered in to prevent post-operative adhesions. The omentum was ligated with mattress sutures and the stump returned to the abdominal cavity. Entire contents of the sac were returned to the abdominal cavity. The sac was ligated high up and cut off and the stump dropped into the peritoneal cavity. The widely dilated external ring was closed completely with chromic catgut. The line of suture was reinforced by overlapping fascia secured with strong mattress catgut sutures.

Patient made an uneventful recovery and left the hospital at the end of three weeks in good condition.

WM. J. THOMPSON, M.D.,
Superintendent Colored Division,
Kansas City General Hospital.

Kansas City, Missouri.

BOOK REVIEW

THE PATHOLOGICAL GALL-BLADDER. By ARIAL W. GEORGE and RALPH D. LEONARD. New York. Paul B. Hoeber, 1922.

This book is the second volume of the *Annals of Röntgenology*, edited by Dr. James T. Case. It takes up the question of depiction of pathologic conditions of the gall-bladder. The well-known proficiency of the authors to visualize, with the X-ray, lesions in this region is well known, and they claim a correct reading and interpretation in eighty-eight and four-tenths per cent. of the cases examined, which have been checked operatively. The details of the technic employed to obtain such results are very definitely and succinctly given.

There are shown 135 Röntgen-ray studies, forming forty-four full-page plates, which show practically all of the pathological conditions which can be found. These include the direct visualization of the thickened gall-bladder, and the relation to the underlying kidney with and without stones; the points of differentiation between renal and gall-bladder lesions, in addition to the indirect evidence of the deformity of the stomach and duodenum from external pressure or adhesion to the gall-bladder. The plates are all beautiful reproductions on very highly calendered paper. These give to the reader types for comparison and interpretation of shadows upon which a very positive diagnosis may be made. Description of the plates are given in English, French and Spanish.

The value of such a publication cannot be overestimated, and must prove of the utmost advantage to the careful clinician, or the surgeon in the proper conduct of cases presenting atypical abdominal subjective symptoms.

JAMES T. PILCHER.

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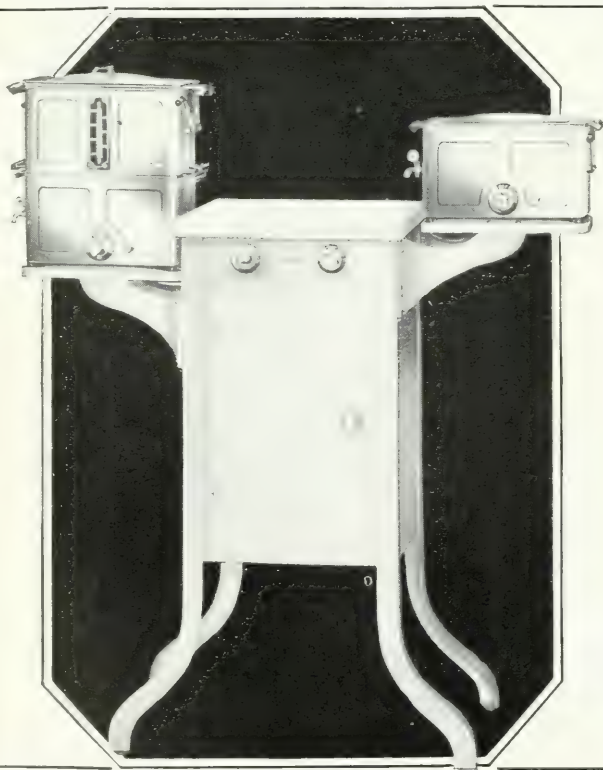
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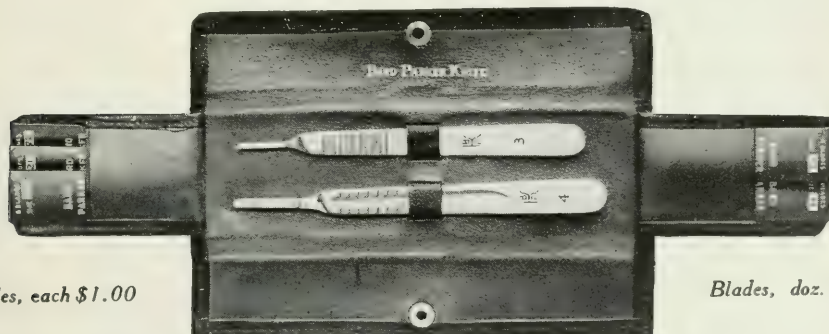
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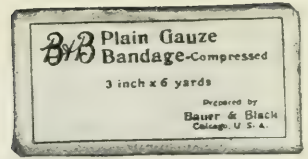
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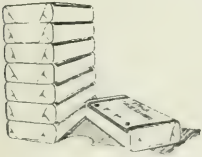
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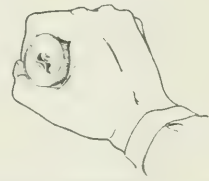
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Claustro-Thermal Catgut

Boilable

CLAUSTRO-THERMAL, meaning *enclosed heat*, is descriptive of the improved method of heat sterilization. The principle of the method consists in applying the heat after closure of the tubes, thus avoiding all the chances of accidental contamination.

The sealed tubes are submerged in a bath of cumol—the high boiling hydrocarbon. The temperature of the cumol bath is gradually elevated until at the end of six hours the maximum of 165° C. (329° F.) is reached. This temperature is maintained for five hours, and is then allowed to slowly decline. The temperature curve is graphically represented by the chart shown below.

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Sterilization by this integral method is made feasible through the use of toluol as the tubing fluid. The discovery of the value of toluol for this purpose was the outcome of an investigation aimed at finding a suitable fluid to replace chloroform. The latter was formerly in general use, but was unsatisfactory because it was found to break down into chemical products which not only exerted an extremely harmful action on the collagen of the

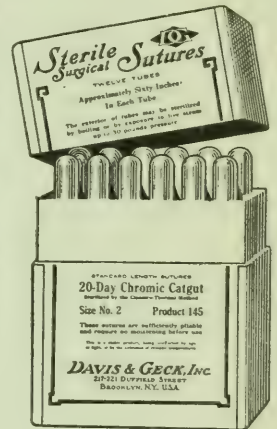
sutures but which were responsible for considerable wound irritation.

No other mode of sterilization so completely fulfills the exacting requirements for the production of ideal sutures as does the Claustro-Thermal method. Through its use the natural physical characteristics of the strands are preserved, while the destruction of all bacterial life is absolutely assured.

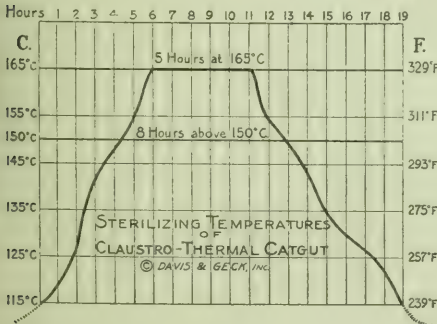
Claustro-Thermal sutures are not impregnated with any germicidal substance, and consequently they exert no bactericidal influence in the tissues.

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See Advertisement on Page 16

CONTINUED—

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An Improved Germicidal Suture Superseding Iodized Catgut

KALMERID CATGUT is not only sterile, but, being impregnated with potassium-mercuric-iodide—a double iodine compound—the sutures exert a local bactericidal action in the tissues.

The older practise of impregnating catgut with the ordinary crystalline iodine for this purpose is at best an unsatisfactory method, since the anti-septic power is but slight and transient. The most serious deficiencies of such iodized sutures, however, are their instability and weakness arising from exposure to light; the deterioration resulting from the continuous and unpreventable oxidizing action of the iodine; and the disintegration of the sutures when heated. Moreover, the decomposition products of iodine cause such sutures to be irritating to the tissues.

These serious disadvantages of iodized catgut have been overcome through the use of potassium-mercuric-iodide instead of iodine. This double salt of iodine and mercury, the chemical formula of which is $HgI_2 \cdot 2KI$, is one of the most active germicides known, exerting a killing action on bacteria about ten times greater than that of iodine. It does not break down under the influence of light or heat, it is chemically stable, and, in the proportions used, is neither toxic nor irritating to the tissues. It interferes in no way with the absorption of the sutures, and is not precipitated by the proteins of the body fluids.

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BOILABLE GRADE—This variety is prepared for surgeons who prefer a boilable suture, such as the Claustro-Thermal product, but possessing bactericidal properties in addition. The boilable grade, therefore, besides being impregnated with potassium-mercuric-iodide, embodies the desirable physical characteristics of the Claustro-Thermal sutures. It has the same moderate degree of flexibility; it is the same in appearance; it is tubed in the same improved storing fluid—toluol; and, after impregnation with potassium-mercuric-iodide, it further receives the Claustro-Thermal sterilization—that is, heat sterilization after closure of the tubes.

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They are genuine kangaroo tendons; they are round, smooth, straight, of uniform contour, and possess a tensile strength about twice that of the best catgut of equivalent size.

Because of their greater strength some surgeons prefer these tendons to catgut, particularly in the finer sizes, for general intestinal, muscle, fascia, and skin suturing.

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The BOILABLE tendons are quite stiff as they come from the tubes, but may be rendered pliable by moistening in sterile water preliminary to use. The smaller sizes will be sufficiently softened by fifteen minutes immersion, while the larger sizes should be immersed for about thirty minutes. Either sterile water, or an aqueous bactericidal solution made with Kalmerid tablets—1:5000—should be used.

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The Non-Boilable Grade is *Product No. 370*
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Standardized Sizes:	0	2	4	6	8
Former Tendon Sizes:	Ex. Fine	Fine	Medium	Coarse	Ex. Coarse

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In packages of twelve tubes of a kind and size

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00	_____
0	_____
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2	_____
3	_____
4	_____
6	_____
8	_____

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The Established Metric System of Catgut Sizes
is Now Used For All Sutures

IN conformity with the long recognized need for a unified system of sizes, the standard metric catgut scale has been extended to embrace all sutures, including kangaroo tendons, silk, horsehair, silkworm gut, and celluloid-linen thread.

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390...Plain Silkworm Gut.....	Four 14-Inch Sutures.....	00, 0, 1
400...Black Silkworm Gut.....	Four 14-Inch Sutures.....	00, 0, 1
450...White Twisted Silk.....	60 Inches.....	000, 00, 0, 1, 2, 3
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872...Plain Silkworm Gut.....	Two 14-Inch Sutures.....	0
882...White Twisted Silk.....	20 Inches.....	000, 0, 2
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With Needles

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914...10-Day Chromic Catgut.....	20 Inches.....	00, 0, 1, 2, 3
924...20-Day Chromic Catgut.....	20 Inches.....	00, 0, 1, 2, 3
964...Horsehair.....	Two 28-Inch Sutures.....	00
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984...White Twisted Silk.....	20 Inches.....	000, 0, 2



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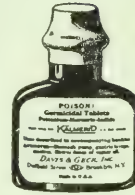
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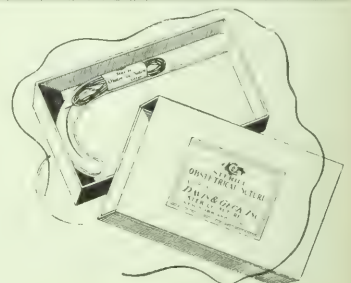
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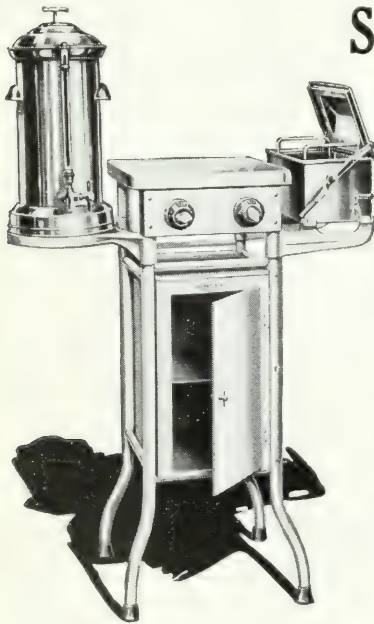
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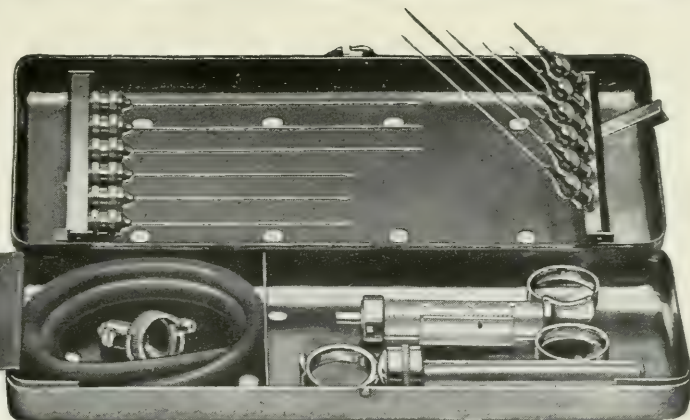
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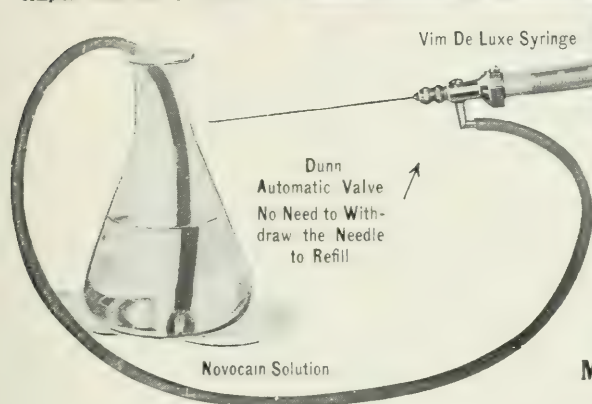
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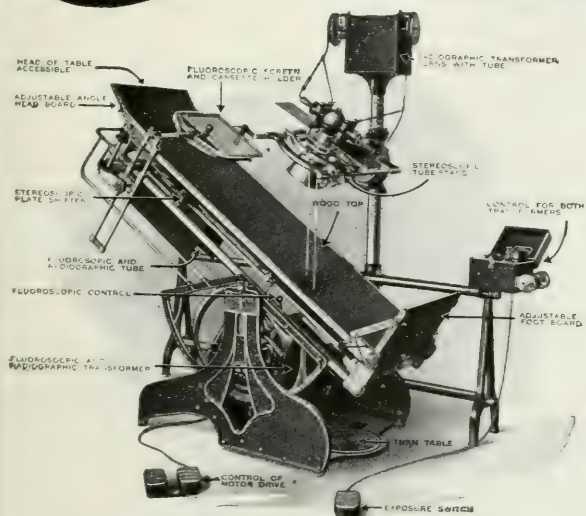
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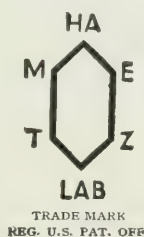
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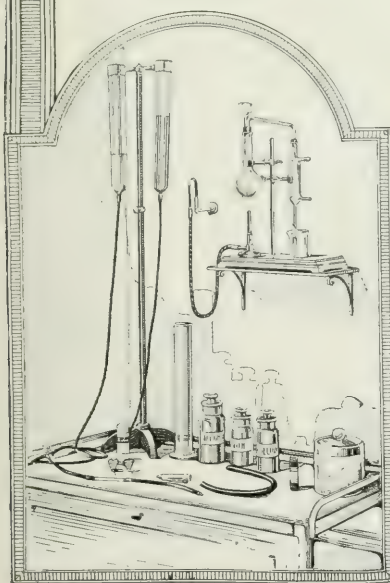
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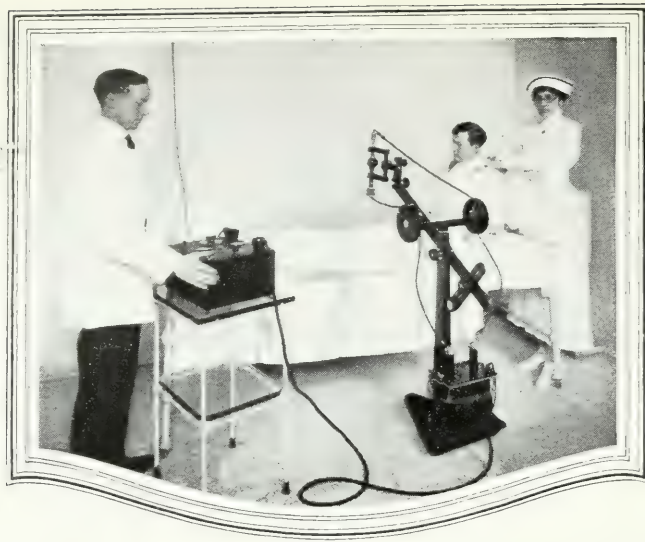
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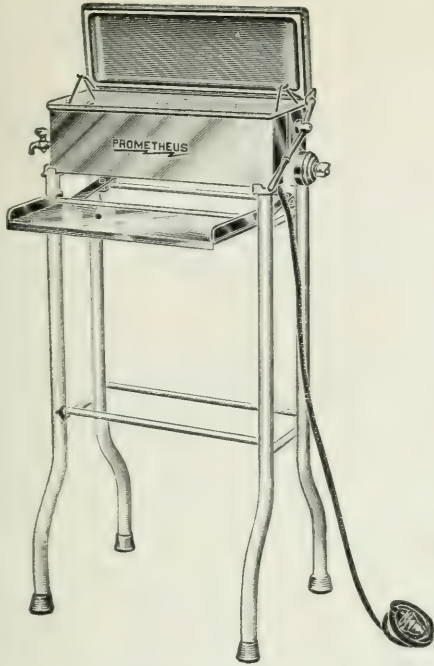
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ANNALS *of* SURGERY

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No. 6

TUMORS OF THE BREAST*

BENIGN AND MALIGNANT—A REVIEW OF 331 CASES

By CHARLES H. PECK, M.D.

AND

WILLIAM C. WHITE, M.D.

OF NEW YORK, N.Y.

THIS record includes 331 cases of tumor of the breast, 136 being benign tumors (forty-one per cent.) and 195 malignant tumors (fifty-nine per cent.).

The majority of these cases have been treated on the Second Surgical Division of the Roosevelt Hospital, the remainder being outside private patients of the authors. It is convenient to consider each group separately.

Benign Tumors and Cysts.—Analyzed from the pathologic standpoint, this group consisted of:

	Cases
Single cysts	23
Localized cystic mastitis	18
Generalized cystic mastitis	13
Papillary cystadenoma	9
Galactocele	2
Adenofibroma	50
Intracanalicular fibroma	14
Tuberculosis	3
Lipoma	2
Hæmatoma	2
	<hr/> 136

The single cysts were for the most part the typical blue-domed cyst of Bloodgood, which we find a relatively common lesion and believe to be always benign. That such cysts may be associated with carcinoma in the adjacent breast tissue, or at a distance, we do not doubt, but such association has not been observed in this series.

The operation of choice is local excision, including just enough adjacent breast tissue to insure complete removal of the cyst wall, which is so thin and adherent as to make true enucleation difficult or impossible.

None of the cases followed have developed malignancy and in one case only was secondary operation for another cyst, one year later, required.

* Read before the New York Surgical Society, January 11, 1922.

Localized Cystic Mastitis.—The cases of localized cystic mastitis, eighteen in number, differ in that more than one cyst, sometimes several of varying size, occur in a localized area of the breast, forming a distinct lump.

In this group a "V"-shaped wedge of breast tissue is excised from the deep surface, including the affected area; the incision being carried through normal breast tissue on either side. After careful hæmostasis, the cut breast tissue is carefully coapted by fine catgut sutures, placed separately through the anterior and deep capsule, including enough breast tissue to secure accurate apposition and prevent the formation of an hæmatoma.

This restores the contour of the breast and is done preferably through a curved incision at the lower border, the breast being reflected upward and the dissection done from the deep surface. The patient should always be warned that a lump will be felt in the breast at the site of excision, which will disappear by absorption in a few weeks' time. The cicatrix is covered by the overhanging breast and is usually quite invisible to ordinary inspection unless the breast is lifted. Two cases in this group developed a similar lesion in the opposite breast later, requiring secondary operation. One case had both breasts involved primarily.

We have long believed that unnecessary mutilation by the performance of radical operations for these distinctly benign conditions was unwarranted, and speaks for lack of ability or confidence in diagnosis by the surgeon, rather than consideration for the future comfort and safety of the patient.

The advice and support of a trained pathologist at the operating table, with frozen sections when in doubt of the nature of the process, is essential to the best interests of the patient in the modern treatment of breast tumors.

General Cystic Mastitis.—There were thirteen cases of general cystic mastitis in which the distribution of the cysts necessitated complete removal of the gland.

The Warren incision is used by preference, the breast being reflected upward and the entire gland removed from the deep surface. Occasionally only a part of the cysts will be tense enough to form palpable tumors, other flaccid or partly filled cysts being scattered throughout the remainder of the gland.

By conserving enough of the subcutaneous fat to build up a pad beneath the nipple by deep sutures, flattening and deformity when healing is complete, can be greatly diminished.

Papillary Cystadenoma.—Our belief that this lesion is essentially benign has been greatly strengthened by Bloodgood's valuable studies and contributions to the literature of this subject. This does not apply to smooth-walled cysts with bloody content, which are essentially malignant and should be so treated.

From a pathological viewpoint there does not seem to be any indication for a radical operation on papillary cystadenomata whether young or old. We have not seen any carcinomatous changes along with any of our papillary

cysts. Our radical operations for this condition were due to the earlier impression that they were potentially malignant. Clarke and Stout report that they have never seen malignancy develop from papillary cystadenoma.

Bloody Discharge from the Nipple.—Blood-stained discharge from the nipple without a palpable mass is not evidence of malignancy and does not call for operative interference. With the presence of a tumor it calls for operation.

Of our nine cases of papillary cystadenoma two had bloody discharge from the nipple. Complete mastectomy was performed in six of the nine cases, in five of which axillary dissection was also done. The remaining three were treated by local excision. The high percentage of radical operations in this group occurred in our earlier cases when we had greater fear of their potential malignancy.

Galactoceles requires little comment; it is quite benign and simple enucleation of the cyst is all that is called for. It is relatively infrequent, only two cases appearing on our records.

Adenofibroma.—This group is the most important of the benign lesions as to diagnosis and selection of operative procedure.

Differentiation of types can be carried to an extreme, and pathologic variations are so numerous as to almost defy classification. A broad general distinction, however, can be made between growths which are distinctly encapsulated and those which are not.

Encapsulated Adenofibroma.—The encapsulated forms are benign and local excision is adequate and safe, even if the histologic type is so cellular as to engender the fear of possible malignant tendency. We believe that this is a safe statement and it is a viewpoint which Bloodgood emphatically supports. Two cases had tumors in both breasts, one case had a secondary operation one month later for a nodule probably overlooked at the primary operation. No case followed developed subsequent malignancy.

Non-encapsulated Adenofibroma.—Non-encapsulated adenofibroma, with or without cystic changes, occupies the borderland, and great care must be taken if such cases are classed as benign, and treated on this assumption. Nevertheless, many cases of this type are non-malignant, and with proper pathologic examination, immediately done by a competent pathologist, may be safely so considered. The gross appearance of the cut tissue is as a rule a better guide to its nature than even a frozen section, though the latter should always be used in doubtful cases. Pathologists of the widest experience, *e.g.*, Ewing, Bloodgood, Clarke and Stout, etc., concur in this opinion.

In this type of lesion other clinical factors must be considered: the age of the patient; the possibility of future pregnancy and lactation; the relative amount of glandular tissue involved; in deciding whether local excision is safe and desirable; whether complete removal of the breast, sparing skin and nipple is sufficient; or the typical radical operation as for cancer should be performed.

The two cases in our benign series in whom cancer developed later

were of this type and in both the complete radical operation was performed primarily.

We are greatly indebted to Bloodgood for his exhaustive and sane analysis of the pathology of this group published in the *Archives of Surgery* of October, 1921.

In two of the cases in this group the breast was completely removed without axillary dissection and in four a complete radical operation was performed.

Multiple tumors in a breast are usually adenofibromata, cysts or tuberculosis. Primary malignant tumors are rarely multiple.

Intracanalicular Fibroma.—Our fourteen cases in this group were all encapsulated, offered no special difficulties in diagnosis and were treated by enucleation or local excision.

This lesion is always safely classed as benign.

Tuberculosis.—There were three cases only of this lesion.

One case operated upon in April, 1912, for multiple masses in the right breast, had a similar process develop in October, 1912, in the left breast, which was also removed. Last examined in February, 1920, she was perfectly well and is believed to be so at the present time. She had a child four years before operation.

A second case is well seven years post-operative and the third died six years post-operative of a non-tuberculous malady.

Two cases of lipoma and two of hæmatoma were included in the records, but require no especial comment.

There were four secondary operations in the series already cited; one for single cyst, one for local cystic mastitis, one for adenofibroma and one for tuberculosis.

Two cases developed carcinoma, but in both, as already stated, the primary operation had been of the complete radical type.

Except for these two cases there have been no late deaths in any way connected with the breast lesion as far as known, and there was no immediate mortality in the series. Some of the other facts noted were as follows:

Sex.—Males: 8

Females: 128

Of the females: 44 were single

76 were married

8 were widowed

8 not recorded

The patients who had lactated numbered: 39

The patients who had not lactated numbered: 62

Not stated: 35

Bleeding from the nipple was recorded in six cases:

2 of papillary cystadenoma

1 of local cystic mastitis

3 of adenofibroma

TUMORS OF THE BREAST

The types of operations performed were:

<i>Complete Mastectomy</i>	15 cases
(Skin and nipple was left in ten cases)	
General cystic mastitis	8
Local cystic mastitis	1
Single cyst	2
Adenofibroma	4
Papillary cystadenoma	1
Tuberculosis	1
	<hr/>
	15 cases
<i>Complete Mastectomy with Axillary Dissection</i>	19 cases
The conditions for which this was done were:	
General cystic mastitis	4
Local cystic mastitis	4
Adenofibroma	2
Papillary cystadenoma	5
Tuberculosis	2
	<hr/>
	19 cases
<i>Partial Mastectomy</i>	12 cases
<i>Local Excision or Enucleation</i>	90 cases
Total	136 cases

The types of incision were:

Curved at lower border	85
Radial	16
Curved at areola	1
Oblique ovoid	22
Transverse ovoid	12

Summary.—(1) Benign tumors or cysts of the breast can be definitely diagnosed at the operating table in a high percentage of cases, and should be treated by conservative surgical procedures. Mutilating radical operations for such conditions are unnecessary and are a confession of ignorance or timidity on the part of the surgeon.

(2) A trained pathologist should be present at the operating table to assist the surgeon in determining at once the nature of the pathologic process.

(3) Cysts of the blue-domed type and localized and generalized chronic mastitis are neither malignant nor precancerous conditions and should not be so considered.

(4) Non-encapsulated tumors of the adenomatous type form a borderline group. They are by no means always precancerous lesions and in younger women radical operations should be avoided if possible. In older patients, and when the amount of breast tissue involved is considerable, radical operation may be indicated.

(5) Multiple primary tumors or cysts are rarely malignant. Possible exceptions to this rule, *e.g.*, a carcinoma developing in a breast already the seat of a benign tumor, have not been observed in this series. This rule does not apply to advanced cases of carcinoma with outlying nodules which are really secondary deposits.

(6) Conservative operations should, when possible, preserve the contour of the breast, and incisions so placed as to leave an inconspicuous cicatrix.

The curved incision at the lower border (Warren) best meets this requirement.

MALIGNANT TUMORS OF THE BREAST

There were 195 cases of malignant disease of the breast in this series, of which four were sarcoma and the remaining 191 carcinoma.

Of this number follow-up reports have been obtained in 118, fifty-nine being dead, or alive with recurrence; fifty-three are alive and well at the present time, twenty-seven of the latter having passed the five-year mark; six post-operative deaths occurred while the patients were still in the hospital.

The unexpected sources from which some of our follow-up information has come would indicate that probably not all of the seventy-seven untraced cases are dead, though the proportion cannot be stated. To cite an illustration, within the past fifteen months, two sisters, operated upon in 1910 and 1912, respectively, from whom no report had been received for several years, were both found to be quite free from recurrence when one was brought to the hospital for acute perforative cholecystitis in October, 1920. Cured cases often wish to forget their unpleasant experience and fears and avoid reporting to the surgeon for fear of something wrong being found.

One can hardly speak of percentages of cures with so many cases untraced, nevertheless the results show some measure of encouragement in spite of this fact.

There were six deaths from the immediate effects of the operation: three due to embolus on the seventh, tenth and fourteenth days post-operative, respectively. One died of shock within twelve hours. One died of cardiac failure due to preëxisting cardiac disease on the fourth day. One died of wound sepsis on the seventeenth day.

In regard to the operative procedure, the following facts have been tabulated:

Complete mastectomy with axillary dissection was done in all of the 195 cases.

Excision of the thoracic portion of the pectoralis major muscle in 186 cases.

Excision of the pectoralis minor muscle in seventy-one cases.

Division of the pectoralis minor muscle with resuture in fifty-four cases.

Excision of a part of the sheath of the rectus abdominis in twenty-three cases.

Plastic or sliding flaps in eight cases.

Skin graft in five cases.

The oblique ovoid incision or some modification of it was done in 114 cases.

The transverse ovoid incision of Stewart was done in eighty-one cases.

The transverse incision of Stewart has been the operation of choice for some six or seven years past. The resulting scar is well placed and does not encroach on the shoulder or arm; there are no cords of cicatrix to interfere with free-arm motion; the exposure of the axilla to its highest point is excellent. The direction of the incision facilitates sliding upward of the lower flap so that skin grafting is rarely necessary, even after removal of larger areas of skin. The pectoralis minor is usually preserved either by division and resuture, or better, by retraction for axillary dissection.

We believe that it tends to protect the axillary vessels from constricting cicatrices and minimizes the danger of œdema of the arm which we rarely see in a marked degree.

We employ block dissection from above and within downward and outward, following the plane beneath the pectoralis major and removing the sheaths of pectoralis minor and serratus magnus. The axilla is drained through a stab wound. We do not excise the supraclavicular glands, having felt that if the disease has involved this group the prospect of a radical cure is slight.

We have not made a special point of excising a portion of the sheath of the rectus abdominis, though it has been recorded in twenty-three of the series and has probably been done in a larger number without mention in the history. It is usually done when it comes naturally in the field of a wide block dissection, as is frequently the case.

We follow the teaching of Handley in making a wide oblique dissection of subcutaneous fat well out beyond the edges of the skin incision, thus removing a greatly augmented area of subcutaneous tissue and muscle sheath.

We believe that extension by diffusion in all directions from the primary growth, especially in the lymph-spaces of the subcutaneous tissue, is a factor of importance.

In doubtful cases the tumor is completely excised with a safe margin of adjacent tissue and immediately cut and inspected by a pathologist and the operating surgeon.

In the majority of malignant tumors gross inspection of the cut surface is quite sufficient to determine the diagnosis, but if doubt exists the result of a frozen section is awaited. We feel that a frozen section diagnosis is of great value in some of the doubtful cases. It should always be interpreted, however, in conjunction with the appearance of the gross section, the presence or absence of encapsulation and the general clinical picture.

Delayed Radical Operation.—We have had eleven cases in which the primary excision of the tumor was followed at an interval of days or weeks by radical operation as a result of pathologic findings: in seven cases the interval was from three to seven days; in two cases two weeks; in one case four weeks and in one case three months. Of the nine cases followed, five are alive and well at ten months, eighteen months, five years, eight years and

ten years, respectively; four died or had recurrence at four months, nine months, one year and four years, respectively. Two cases have not been traced.

Delayed radical operation after excision of the tumor for diagnosis is never the procedure of choice, but as our results show, is not invariably followed by fatal recurrence; in fact, though the number of cases is small, the percentage of cures is quite as large as with the other methods.

Diagnostic Points.—The history of the length of the time the tumor has been observed, we have found to be of little help. The same may be said of the lack of retracted nipples, adhesions to the superficial or deeper tissues, palpable axillary lymph-nodes, pain and tenderness or history of trauma.

TABLE I
Local Exploratory with Secondary Operation Later

	Interval	Tumor	Present
1	2 weeks	Medullary no metastasis	O.K. ten years
2	3 months	Adenocarcinoma with metastasis	Died one year later
3	7 days	Adenocarcinoma with metastasis	Recurrences 4 months later
4	27 days	Medullary carcinoma no metastasis	O.K. 10 months
5	2 weeks	Adenocarcinoma no metastasis	O.K. 18 months later
6	3 days	Scirrhus carcinoma with metastasis	O.K. 8 years
7	4 days	Scirrhus carcinoma with metastasis	Died 9 months later
8	6 days	Medullary with metastasis	Died 4 years later
9	2 weeks	Adenocarcinoma no metastasis	O.K. 5 years
10	3 days	Scirrhus carcinoma no metastasis	Lost
11	1 week	Medullary no metastasis	Lost

Metastasis means axillary involvement.

Presence of retracted nipples and adhesions to the superficial tissue, as shown by the orange-peel appearance, on the contrary, are of great help. Axillary nodes are often palpable in benign tumors and often not palpable in malignant tumors. The sense of hardness is often of some help, while multiple primary nodules rather point toward a benign condition, but not absolutely so.

When cut open after the tumor has been excised, one may be influenced by the gritty hard feeling to the knife, the absence of capsule and the minute yellow dots.

In the case of a sarcoma, one is more dependent upon a frozen section, because the gross picture is often confused with an œdema-tous adenofibroma.

We have not had any malignant tumor in a patient under twenty-five years of age, but in the presence of absolute signs we would not hesitate to do a radical operation in a young woman under that age.

The cases described as Paget's disease were frankly malignant, and although they did not perhaps come under the original description by Paget, still we have called them by that name, because of the general custom. Both of these cases were lost to our recall system.

TUMORS OF THE BREAST

The one case of sarcoma that we have followed has been alive for nine years, and is now well. The diagnosis was made by a competent pathologist, but we have no microscopic description or slide of the case.

The carcinomas have been put in three classes, although it is admitted that it is not a division into very distinct groups, and our recall notes do not help us show that there is any particular difference in their virulence, in spite of the general tradition. What we have noted is what we would have expected, that the cases without metastases have a better outlook.

We have used post-operative X-ray treatment as a routine procedure for the past three or four years, but the cases are too recent to draw conclusions

TABLE II
Recurrences or Deaths

Years	Adeno- carc. with Metas- tasis	Adeno- carc. without Metas- tasis	Scirrhus carc. with Metastasis	Scirrhus carc. without Metastasis	Medullary carc. with Metastasis	Medullary carc. without Metastasis	Carcinoma with Metastasis	Cancer with Metastasis	Cancer without Metastasis
0	8	0	1	1	3	0	0	12	1
1	9	3	1	0	5	1	1	16	4
2	2	0	3	2	3	0	0	8	2
3	3	0	0	0	3	1	0	6	1
4	1	0	0	2	1	0	0	2	2
5	0	1	0	0	0	0	0	0	1
6	1	0	0	0	0	0	0	1	0
7	1	0	0	0	0	0	0	1	0
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	1	0	0	0	0	0	0	1	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	1	1	0
								48 cases	11 cases

from. We believe that it is good insurance and may retard or prevent recurrence in certain cases. We also advise X-ray or radium when recurrence is actually present and think it effects retardation of the growth and often gives increased comfort, but up to the present time we have seen no cases cured.

A study of the histories of the 195 cases brought out some facts of interest in history and physical examination—only positive statements are recorded:

57 cases had retracted nipples.

16 cases had ulcerated skin areas.

94 cases showed adhesion to the skin.

31 cases showed adhesion to deep muscles.

9 cases showed multiple nodules (mostly advanced cases with secondary nodules).
 77 cases showed palpable axillary nodes.
 109 cases showed axillary nodes involved at time of operation.
 70 cases had lactated previously.
 68 cases had not lactated previously.
 15 cases gave a history of previous trauma.
 15 cases complained of pain and tenderness.
 There was only one male in the series.
 Analysis of the pathologic findings and their relation to results as shown in the tables is of considerable interest:

TABLE III
No Recurrence. Alive and Well Now.

Years	Adeno-carc. with Metas-tasis	Adeno-carc. without Metas-tasis	Scirrhus carc. with Metas-tasis	Scirrhus carc. without Metas-tasis	Medul-lary carc. with Metas-tasis	Medul-lary carc. without Metas-tasis	Carci-noma with Metas-tasis	Carci-noma without Metas-tasis	Total Cancer with Metas-tasis	Total Cancer without Metas-tasis
0	1	0	2	2	1	3	0	0	4	5
1	2	3	0	1	0	2	0	0	2	6
2	0	0	1	2	0	1	0	0	1	3
3	0	2	0	2	0	0	0	0	0	4
4	0	0	0	0	0	1	0	0	0	1
5	0	1	1	1	3	0	0	0	4	2
6	0	2	0	0	0	1	0	0	0	3
7	1	1	0	0	2	2	0	0	3	3
8	0	2	1	0	0	0	0	0	1	2
9	0	1	0	1	1	0	0	1*	1	3
10	0	1	0	0	0	0	0	0	0	1
11	0	2	0	0	0	0	0	0	0	2
12	0	1	0	0	0	0	1	0	1	1

* 1 equals fibrosarcoma
 Cancer with metastasis 17
 Cancer without metastasis 36 } 53

78 cases were classed as adenocarcinoma.
 53 cases were classed as scirrhus carcinoma.
 58 cases were classed as medullary carcinoma.
 2 cases were classed as Paget's disease.
 4 cases were classed as sarcoma.

Of the fifty-nine cases traced which died or have recurrences, forty-eight cases had axillary glands involved at the time of operation; eleven cases had no axillary gland involvement.

Of the fifty-three cases now alive and well, seventeen cases had axillary glands involved; ten of these are well more than five years; thirty-six cases had no axillary involvement; seventeen of these are well more than five years.
Cases Operated Upon Before January 1, 1917 (More Than Five Years Ago)

We have definite follow-up information on sixty-nine cases operated upon more than five years ago. Of these there are:

TUMORS OF THE BREAST

Dead or alive with recurrence	42
With axillary metastases at time of operation	33
Without axillary metastases at time of operation.....	9
	—
	42
Alive and well	27
With axillary metastases at time of operation	10
Without axillary metastases at time of operation	17
	—
	27
	—
	69

A study of this group shows that our percentages correspond closely with those reported by Sistrunk and McCarty in the ANNALS OF SURGERY for January, 1922; of our 69 cases there were:

Alive and well more than five years.....	39 per cent.
Alive and well more than five years; cases with meta-	
stases.	23 per cent.
Alive and well more than five years; cases without	
metastases	65 per cent.

PAPILLARY CYSTADENOMA OF THE MALE BREAST*

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THE occurrence of tumors in the male breast is relatively uncommon. Of 2420 cases of breast tumor collected by Roger Williams,¹ only twenty-five, or one per cent., occurred in the male breast. Gebele² reported 359 consecutive breast tumors from Angerer's clinic, of which not one occurred in the male breast. Of the twenty-five cases reported by Williams, sixteen were carcinoma, three were sarcoma, two were myxoma and one each were adenoma, lipoma, angioma and cystoma. The rarity of benign tumors of the male breast is emphasized by these statistics. Schuchardt³ collected nearly 500 tumors of the male breast from the literature, a large per cent. of which were carcinoma. He collected instances of nearly all of the benign tumors of the breast, including five papillary cystadenomas.

The cystic feature of a large proportion of benign tumors of the breast is well known. Bloodgood,⁴ in a recent well-illustrated article, has classed all cystic tumors of the breast as chronic cystic mastitis and has demonstrated adenomatous, cystic and inflammatory features in practically all of the varieties. Even the papillary structure of the epithelium is occasionally, and in some instances frequently, found in the different types of cysts.

Probably the most commonly seen cysts are the large ones which are slow growing and usually appear before the menopause. They are smooth-walled, contain clear or cloudy fluid (blue-dome cyst, Bloodgood) or contain a milky fluid (galactoceles). They occur in breasts undergoing adenomatous and not infrequently inflammatory changes.

Diffuse cystic mastitis, often affecting both breasts and associated with multiple small cystadenomas and inflammatory reaction in the stroma, is a much discussed lesion, not only in an attempt to accurately catalogue it pathologically, but also to ascertain its tendency to malignant degeneration. Astley Cooper, Reclus,⁵ Schimmelbusch,⁶ König,⁷ Saar,⁸ Warren,⁹ and Bloodgood¹⁰ have especially contributed to our knowledge of the pathology and clinical picture of the disease. This condition, often referred to as Reclus disease, Schimmelbusch disease, chronic cystic mastitis or senile parenchymatous hypertrophy, is regarded, respectively, as a cystadenoma, an inflammation with cyst formation, or a hypertrophy of the epithelium of the acini with cyst formation. Papillary outgrowths in the cysts are frequently described and regarded as an inclination to malignant degeneration, which actually occurs in about ten per cent. of the cases.

Another relatively common cyst in the breast is the duct cyst or duct papillary cystadenoma, which may be single or multiple, involves the large

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ducts of the breast and is usually situated under the nipple. Greenough and Simmons,¹¹ Deaver and McFarland,¹² Bloodgood, Judd²⁶ and Lewis have given splendid descriptions of this lesion. Greenough and Simmons have reported twenty cases from the records of the Massachusetts General Hospital and Deaver has collected forty cases from the literature. As it is this type of tumor which serves as the subject of the report, a summary of its chief characteristics will be given.

Incidence of Age.—Thirty-five per cent. of the cases were in patients under fifty years of age and thirty per cent. were between fifty and seventy. The youngest patient was nineteen and the oldest eighty-one.

Incidence of Sex.—This tumor is essentially one of the female breast. In a fairly comprehensive search through the literature, only eleven cases have been discovered in which the tumor was present in the male breast. A few others are described in which carcinoma of the male breast probably resulted from a malignant degeneration of a papillary cystadenoma of the male breast.

Location of the Tumor.—The tumor is usually under the nipple or near it. It is seldom bilateral. It rarely projects above the surface of the skin. It is well circumscribed and not attached to the skin or pectoral fascia except in very old neglected cases, where the skin may be adherent to the tumor and undergo color changes incident to interference with circulation. Six of the thirty cases reported by Greenough and Simmons had the skin over the tumor adherent to it. The nipple may be somewhat retracted when the tumor is under it.

The Size of the Tumor.—The size of the tumor depends somewhat upon the length of time it has been present, but usually varies from a small nodule to the size of one's fist. The average size is about that of an English walnut. Rarely the cyst may rupture externally and present a fungoid cauliflower appearance which has been described as pseudo-sarcoma phyllodes (Müller).

The duration of the tumor in the described cases has been about two years.

Axillary glands are usually not enlarged, though Greenough and Simmons report two cases with enlarged axillary glands which were probably on an inflammatory basis.

Symptoms.—The most characteristic symptom, in addition to the slowly growing tumor under the nipple, is a discharge from the nipple, which is present in about seventy-five per cent. of the cases. The discharge is usually milky but may be bloody. Deaver states that twenty-five per cent. of the cases have a bloody discharge. Pain may be present and is usually in the region of the tumor. It is not a prominent symptom and is present in only about one-third of the cases.

Pathology.—In addition to the gross appearance of the tumor already described, on cross-section the tumor consists of one or more cysts containing blood-stained fluid. The whole cavity of the cyst may be filled with red friable tissue which is papillary epithelial growth. More commonly only one part of the wall of the cyst has undergone papillary proliferation, while some

of the smaller cysts may have no papillary outgrowths from the cyst wall. These papillary structures may have a pedunculated or a sessile attachment to the wall of the cyst. In the latter instance they appear somewhat like sago, being rounded and of dull color, while in the former they consist of waving, finely divided, arborescent epithelial processes. Where the cavity of the cyst has been filled by the papillary outgrowth, the cross-section of the tumor may appear more like a solid tumor with a soft friable bloody centre.

Microscopically the wall of the cyst is lined by a columnar or cuboidal epithelium, unless the cyst is quite old, where the epithelial lining may be absent except over the papillary outgrowths. The papillary processes usually have a branched connective-tissue stalk in which are small blood-vessels. When they are sessile and have a wide basal attachment on the cyst wall, the cyst can be distorted by their growth, with the result that many branching clefts are formed and in the end cauliflower or leaf-like structures result that have been named pseudo-sarcoma phyllodes (Sarr⁸).

The fine arborescent papillary growths undergo degeneration and necrosis and bleeding takes place into the cyst.

The connective-tissue stroma surrounding these cysts is often overgrown and rich in nuclei. Hyalin degeneration is seen in some areas and foci of round-cell infiltration are common.

After local surgical removal of these papillary cystadenomata of the ducts, recurrence may take place. Greenough and Simmons report two recurrences in ten cases where local removal was done. One of these recurrences was reoperated upon and the tumor was found to be of the same structure as the original tumor. The other recurrence was not reoperated upon but the recurrence did not appear malignant.

Ziegler and Kaufmann both speak of the tendency of these papillary tumors to undergo malignant degeneration. Tietze¹³ thinks ten per cent. undergo malignant degeneration. In Greenough and Simmons' cases, fifteen per cent. had undergone malignant degeneration.

Treatment.—In view of the tendency to malignant degeneration shown by these tumors and of their tendency to recur after local removal, it is the prevailing opinion that they should be treated by removal of the breast.

CASE REPORT

The case to be reported, occurring in a male breast, is unusual in addition to the sex of the patient from the standpoint of the patient's age, the duration of the tumor, its recurrence after local removal as well as its appearance after eleven years' growth.

A male, eighty-two years of age, was admitted to my service in the Cook County Hospital in August, 1921. Considering his age, his general condition was good. Fifteen years ago he noticed a small lump under the left nipple and shortly after this, a milk-like discharge from the nipple began which persisted until local removal of the tumor and nipple three years after its first appearance. About a year after the local removal, a small nodule developed to one side of the scar and this has grown slowly. Later two other nodules developed in close proximity to the first recurrence, and these have slowly but steadily grown for



FIG. 1.—Cystadenoma in a male breast.



FIG. 2.—A. Papillary outgrowth arising from the cyst wall.
B. cyst wall. Note absence of epithelial lining.

the past eleven years until they fused together into a three-knobbed tumor, which during the past few years has been attached to the skin overlying the tumor (Fig. 1). The skin has become thin, shiny and discolored, ranging from blue at the base of the tumor to red at the apices of the three prominences. During the past two years, a small tumor the size of a walnut, has been developing apart from the main mass at the lower border of the pectoralis major in the lower outer quadrant of the breast. This tumor is only slightly attached to the skin and has relatively little color changes over it. All of the tumor mass is movable on the pectoralis fascia. The axillary glands are not enlarged.

The pre-operative diagnosis was tumor of the male breast, probably sarcomatous in nature, due to its resemblance in appearance to sarcoma of the fascia lata, for example, which in color, consistency, nodular appearance and attachment to the skin it closely simulated. Against this diagnosis was the general health of the patient, the length of time the tumor had been present, mobility of the tumor on the fascia of the pectoralis and absence of metastases.

The tumor, including all of the skin over it, was widely removed as well as all of the pectoralis major muscle and fascia up to the attachment of the muscle to the humerus. This was done under local anæsthesia and was well borne by the patient. A defect the size of the palm of the hand was left which was Thiersch-grafted three days later. All of the grafts took and the old man was discharged from the hospital. He has been under observation only four months, but up to the present time is well and relieved of his discomfort.

Pathology of the Tumor Removed.—On cut section, the tumor nodules were found to be cystic, containing bloody fluid under tension. For the most part the walls of the cysts were smooth, but over areas of from two to three centimetres on the walls of the several cysts, small sessile hyalin-looking bodies were seen which, though not arborescent in character, grossly resembled papillary projections of the epithelium. Sections through these areas did not reveal any tendency to breaking through the walls of the cysts.

Microscopically, the walls of the large cysts were not covered with epithelium but projecting into the cavity of the cysts were stalks of connective tissue containing blood-vessels which were covered with low columnar epithelium. At no place were epithelial cells found invading the wall of the cysts or the stroma surrounding them. Free, unattached pieces of epithelium of the same papillary form were found in the several cysts.

The stroma was rich, had numerous areas in which blood pigment was seen as well as areas of hyalin degeneration of the connective tissue and regions which contained clumps of round cells.

The diagnosis was recurrent papillary cystadenoma of the ducts of the breast.

In reviewing the literature a small number of similar tumors occurring in the male breast were found recorded. Perhaps the most elaborate description of a case is by B. Worbs,¹⁴ who made the case report the subject of an Inaugural Dissertation (Bonn, 1902), a copy of which I have been able to secure from the library of the Surgeon General at Washington.

His patient was a male, forty-five years of age, who for ten years had noticed a tumor under the nipple which was accompanied by an occasional discharge of milky fluid from the nipple. The tumor had gradually grown in size until it reached the size of a fist and the skin became blue over it. The nipple became slightly retracted, but no axillary glands were palpable and the tumor mass was movable on the fascia of the pectoralis major. The author removed the tumor, leaving the muscle and fascia under it. On opening the cysts, which had bloody

fluid contents, the walls were for the most part smooth, but in places contained small cauliflower excrescences which nearly filled some of the smaller cysts. One small cyst was completely filled with papillary outgrowths and gave the appearance of a solid tumor. On microscopic section, the cysts were lined with high cylindrical epithelium and sections through the papillary structures showed connective-tissue stalks covered with low epithelium. The stroma around the cysts was rich and contained many areas of round-cell infiltration.

CASE II.—Reported by Strasser,¹⁵ and quoted from Deaver and McFarland, was a male sixty-three years of age with a tumor of the breast of four years' standing, which had been accompanied with a serosanguineous discharge from the nipple.

CASE III.—Reported by Russell,¹⁶ and quoted from Deaver and McFarland, was in a male sixty-three years of age with a tumor of the breast of four years' standing, upon removal of the breast a cystadenoma of the duct was found.

CASE IV.—Reported by Williams,¹⁷ and quoted from Deaver and McFarland, concerns itself with a pathological specimen from the male breast in the Hunterian Museum which corresponds to the tumor under discussion.

CASE V.—Tietze¹⁸ reported a breast tumor in a young man where first one breast and then the other was involved by a tumor about the size of a walnut and was accompanied by pain. On removal of the tumors and microscopic examination of the same, a rich connective-tissue stroma was found surrounding a cyst wall which had definite infoldings and which produced papillary structures in the cyst. This is a case where some doubt exists as to the papillary cystadenomatous character of the tumor.

CASE VI.—Reported by Greenough and Simmons as a case of Dr. William Conant¹⁹ at the Massachusetts General Hospital, where a male fifty-one years of age had a tumor of the breast, walnut in size, which had been present four months. The tumor was in the upper outer quadrant of the breast and was accompanied by a bloody discharge from the nipple. At operation a papillary cystadenoma of the ducts was found and the breast was amputated. At the end of sixteen months the patient was well and no recurrence had taken place.

CASE VII.—Blasius²⁰ removed a pea-sized papillary cystadenoma from a male breast.

CASE VIII.—Gowland²⁰ reported a duct cyst in a male breast.

CASE IX.—Hewett²¹ observed a papillary cystadenoma of the duct in the breast of a male fifty-five years of age.

CASE X.—Silva Amado²² observed cystadenoma with papillary outgrowths from the cyst wall in a male.

CASE XI.—Morgan²³ reported a papillary cystadenoma of the male breast.

Several cases are reported where carcinoma developed upon what was a benign papillary cystadenoma of the duct in the male breast (Peachell,²⁴ Shattuck²⁵ and others).

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PAPILLARY CYSTADENOMA OF THE MALE BREAST

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AN IMPROVED METHOD OF SKIN-GRAFTING

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SKIN-GRAFTING has been practiced since primitive times. Many unique methods have been devised and used by the surgeon with varied success. But it goes without saying that a thorough working knowledge of these different types of skin-grafts with their indications is the "sine qua non" of the successful plastic surgeon, and without it he will be at a loss to account for his failures. It should be generally understood that the principles of skin-grafting are to be applied only to superficial lesions, but frequently the contour of such lesions is so irregular, so uneven, that the surgeon is put to his wits' ends to devise a method whereby his graft can be kept in accurate coaptation with the underlying tissue throughout the extent of the lesion and this condition be uniformly accomplished at each sitting.

Confronted thus with a series of such problems following war wounds of different types and receiving his inspiration from the Esser epithelial inlay (vide, *ANNALS OF SURGERY*, March, 1917), Colonel Keller conceived the idea of applying the mechanical principles that underlie and form the basis for success in the Esser epithelial inlay to the needs of general surgery. These principles are accurate coaptation of the graft throughout the area to be epithelized, combined with firm pressure and tension over this area. If these three things can be accomplished, then no secretion of any consequence can form beneath the graft and separate it from the granulating surface and conditions are now propitious for the budding capillaries to extend upwards and take root, as it were, in the graft, and thus render it viable. Furthermore, these same three factors prevent, to a large degree, the condition of passive congestion or venous stasis which, as is well known, would in itself be fatal to the viability of the graft after three or four days.

The operation to be described has been of particular value in treating old contracted scars with poor nutrition and often surmounted with indolent ulceration, which it was impossible to sterilize, or to cover with healthy granulations. It has served to break the continuity in painful or contracted scar tissue without ulceration, but which contraction prevented the full function of the part. It has also served to fill in cavities or bony defects following chronic osteomyelitis, and finally it has resulted in the area under treatment being covered with epidermis of normal appearance, a desideratum of no small consequence when cosmetic results are desired.

The technic of this operation is as simple as it is universally applicable where skin-grafts are indicated. It consists in the usual preliminary preparation and the use of the same instruments that one would employ if he were doing a simple Thiersch graft plus the addition of sterile dental modelling composition. With two basins of sterile water—one hot and one cold—

conveniently at hand, the dental composition is first softened in the hot water and then moulded over the surface to which the graft is to be applied and finally placed in the cold water to harden. If the surface to be treated is a broad, flat one, the moulding of the composition may be facilitated by compressing it between two sterile wooden tongue depressors or it may be flattened by using the round handle of some instrument in the same fashion as one would use a rolling pin, until it has reached a suitable thickness. This layer of composition while soft is then held in firm contact with the area to be epithelized and so in this way receives an exact impression of the deformity to be treated. In the event that this deformity is in the shape of a cavity or depression, a sufficient amount of the softened composition is used to fill the defect entirely, and it is held there by firm pressure until hardened sufficiently to permit removal, when it will bear the imprint of every nook and crevice that must be covered with epithelium. A full thickness autoplasmic graft through the dermis into the subcutaneous plexus, but devoid of fatty tissue, is removed with a razor in the ordinary manner, turned inside out over the impressed surface of the composition and held under tension against it by means of fine catgut sutures used to approximate the free edges of the graft across the blank surface of the composition. It may take several grafts before the surface of the mould is covered in the desired fashion. The skin edges about the area to which the graft is to be applied are slightly undercut, so that the margins of the composition with the graft overlying them will slip under these edges. The graft is now placed in position and adjusted, this adjustment being made more accurate by applying a compress soaked in hot saline to the composition for a moment, slightly softening it, when firm pressure will permit such readjustment as is necessary in the composition after the skin has been applied over it. The skin margins surrounding the area made free by undercutting are now sutured with fine catgut to those portions of the graft in apposition to them; which step serves the double purpose of holding the graft in position and at the same time helps to maintain tension on it. A copious dressing with a firm bandage is then applied over the whole area and left undisturbed for a period of eight to ten days, when the sutures holding the graft to the mould are cut, the edges of the composition gently lifted so as not to disturb the graft, and finally the whole mould is removed, leaving the epidermized surface beneath.

REPORT OF CASES

CASE I.—The first patient on whom this operation was performed but in a slightly modified manner from that described above, yet with most gratifying results, was injured by a machine gun bullet on July 18, 1918, at Chateau Thierry, the bullet perforating the leg just below the knee. Gas gangrene set in necessitating many incisions of the leg, followed by an osteomyelitis of the tibia. At the time of operation at this hospital, there were several healed scars on the anterior surface of the leg and a large scar twelve inches long and two inches wide, extending above the popliteal space downwards almost to the insertion of the tendo Achillis with contraction sufficient to prevent complete extension of the leg and so poorly

nourished that any effort at extension resulted in blanching of the scar. There was an ulcer 1 by 2½ inches in the centre of the scar which harbored the staphylococcus aureus organism and resisted all methods of sterilization. Numerous unsuccessful attempts had been made to heal this ulcer.

On August 6, 1920, under gas oxygen anæsthesia, several rectangular grafts were removed from the thigh of the same leg by a safety razor blade, turned inside out over the dental composition and sutured. A longitudinal incision was made on either side of the scar, the intervening tissue tunnelled beneath and the first graft inserted on the freshly cut area beneath the tunnel. Another tunnel was made below the granulation tissue of the ulcer and a second graft placed therein. A Thiersch graft was placed on the lower end of the ulcer and held by a slit through the scar tissue.

An incision was made across the scar tissue and a small inlay graft placed in that slit in such a manner that the raw surfaces of the graft were in contact with the raw surfaces of the cut. The first step was done with a view of lengthening the contracted scar tissue and relieving the tension on the ulcerated area, thereby improving its nutrition. The second step was made with the hope that the overlying granulation would hold the graft firmly in place until the epithelialization could take place beneath, as all previous grafts on the unsterile surface of the ulcer had sloughed completely in two or three days. The whole procedure was done with the idea of allowing the rigid scar tissue to stretch further.

On August 14, 1920, nine days after operation, the roof of the tunnel above the dental composition was cut, and the dental composition removed, revealing epithelialization of the floor without any sloughing of the graft. As was expected, there was some sloughing of the bridge of granulation tissue overlying the second graft, but these shreds of necrotic tissue were cut away, leaving a well epidermized floor beneath.

CASE II.—This was one of marked contraction with limitation of motion due to extensive scar tissue formation between the left thumb and index finger following a severe electric burn of the third degree in the sulcus between the first and second metacarpus. Under gas anæsthesia, an oblong incision was made between the thumb and index finger which removed the entire thickness of the scar tissue in the area excised and permitted full abduction of the thumb. The skin surrounding the incision was undercut for about an eighth of an inch, and a composition mould was taken of the area. A full thickness graft was secured and prepared over the mould under tension by sutures and then put in place and the mould readjusted by the use of a hot compress to obtain accurate approximation with the denuded area and the adjacent margins of the skin and graft sutured together with fine catgut. A dry dressing with a cotton pad to afford elastic pressure was then applied and the hand immobilized with the thumb well abducted by splinting. Eight days later when the dressing was removed and the mould lifted out, it was found that the graft had taken in toto without any maceration or absorption and no tendency toward contraction between the thumb and index finger. Since that time he has been given a limited amount of physiotherapy and now has practically a complete return of full function in this thumb.

The accompanying illustrations (Figs. 1-5) show the condition before and after treatment and the various phases of the operation employed to effect a cure. Essentially the same technic was used in all the other cases reported here, modified only to the extent of meeting the various conditions confronting the operator.

CASE III.—This case was also a burn followed by marked flexion of the right little finger due to the contraction of scar tissue resulting from the burn. An incision was made and all the scar tissue removed after it was determined that the

PLATE I CASE 2



FIG. 1.—Typical deformity due to contracting scar-tissue.

PLATE II CASE 2



FIG. 2.—Scar-tissue excised and denuded area ready for impression on modelling composition.

PLATE IV—CASE 2



SHOWING DENTAL WAX
COVERED WITH SKIN GRAFT

PLATE III—CASE 2

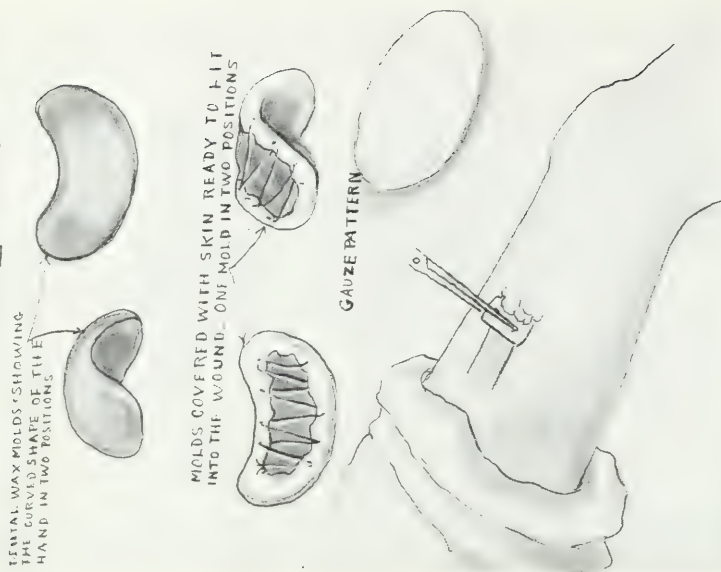


FIG. 1. Graft in position showing method of suturing to hold both mould and graft in place during convalescence.

FIG. 3. Various steps in the preparation of the mould and application of grafts to the same, inside out.

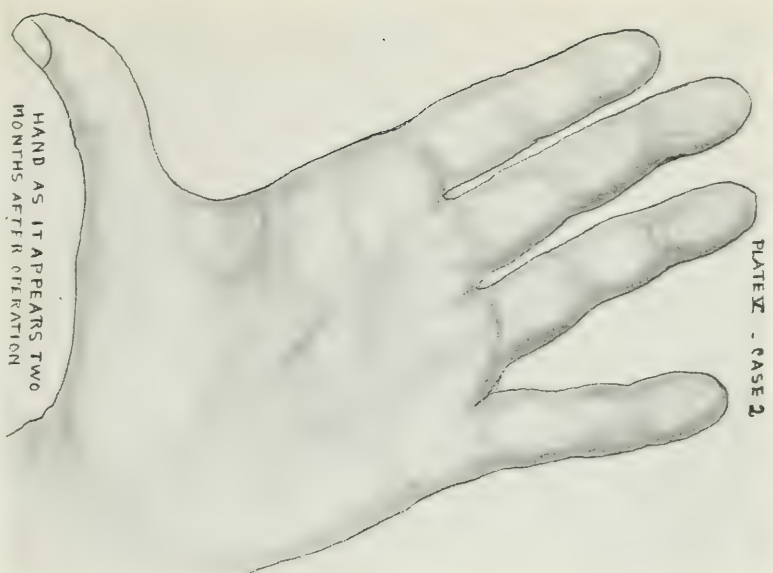


FIG. 5. - A typical end result following the application of this method.



FIG. 6. - Another typical result following the use of this method.

flexor tendon was not incorporated in the scar. Complete extension of the finger was then obtained. A mould was made of the excised area and the remainder of the operation was the same as given in Case II, with very satisfactory results.

CASE IV.—Presented a chronic indolent ulcer on the outer surface of the left ankle over the external malleolus following a gunshot wound received in action on October 9, 1918. This case had the usual train of symptoms, including osteomyelitis with ankylosis of the joint and finally had reached a point where all efforts to heal the resulting ulcer had failed. The ulcerated area was excised, actively dakinized for a short period, and then, under gas anæsthesia, a mould was made of the area with composition, covered with a graft which was applied in the usual fashion and a good result obtained despite the very limited blood supply to that particular region.

CASE V.—This patient presented the problem of epithelizing a narrow but deep granulating area in the lower end of the femur, the result of a high explosive shell injuring the right knee and incurred in action on October 8, 1918, followed subsequently by removal of the patella and extensive osteomyelitis of both the femur and tibia. On account of the wide area of the scar tissue surrounding this region, it was impossible to do a sliding operation or utilize a fat graft, so a mould was made of the cavity, a graft put around it in the usual fashion and the mould placed back into position. Despite the sharp curvature at the bottom of the cavity, the graft was entirely successful and still maintains its integrity notwithstanding active treatment to other lesions in this area.

CASE VI.—This case was one of stricture of the anus due to contracture of scar tissue following extensive operations at other hospitals for epithelioma of the anal region involving the sphincters and subsequent plastic operations to overcome the condition. The anal opening would barely admit the tip of a small size probe and the patient was compelled to take large doses of mineral oil or saline to keep his stools in a liquid state so that they could be evacuated through this minute opening. Under gas anæsthesia, three radiating incisions were made outward from the anus and carried well downward through the scar tissue, one laterally on either side and one posteriorly in the median line. No incisions were made purposely in the median line anteriorly with the idea of using the anterior semicircular flap as a valve to assist in overcoming incontinence, which assumption subsequent events proved was well warranted. Softened dental composition was forced down into the three incisions, and impressions taken of them. Over these impressed surfaces, grafts were sutured with fine catgut, and the moulds, with the superimposed grafts, placed in their respective incisions where they were held in position by a continuous row of sutures passed back and forth through the edges of the skin incisions in the anal margin across the blank surfaces of the moulds. A rubber tube of very small calibre was inserted in the anal canal to allow the expulsion of flatus and what little discharge might occur, and the patient constipated with opium. At the end of six days, the patient's bowels were opened, when it was found that the three incisions were lined with epithelium and that the anal orifice readily admitted the index finger. A subsequent plastic operation of a similar nature improved the condition to quite a degree so that the patient can now lead a fairly normal life.

CASE VII.—This patient had a chronic ulcer of two years duration on the inner surface of the left foot, one of the sequelæ of a high explosive shell injury with extensive destruction of the tissues in this region. Several attempts had been made to close over this area, but with little success, and, when the patient came under observation, he presented an ulcer with an irregular outline $3\frac{1}{2}$ inches long and $\frac{3}{4}$ to $1\frac{1}{2}$ inches wide, running longitudinally beneath the inner malleolus. A preliminary operation was performed under gas anæsthesia which consisted of

complete excision of the granulating area and plastic diminution of the same followed by active dakinization. Twenty-six days later, the granulating wound was gently curetted and the general oozing controlled by Dakin compresses. A mould of softened dental composition was made of this very irregular cavity, covered with grafts and replaced. The undercut edges of the ulcer were sutured to the grafts. A firm and copious dressing was applied, and ten days later, when it was removed together with the mould of dental composition, the grafts were found to have been successful throughout their entire extent.

CASE VIII.—This patient presented an oval ulcer, two inches long by one and three-quarters inches wide, on the inner border of the right foot following chronic osteomyelitis, the result of a gunshot injury to this region. For the past six months the ulcer in question had resisted all the ordinary methods of treatment, and consequently it was given a brief period of dakinization before this method of skin grafting was attempted. At the completion of this period, a mould was taken of the ulcerated area, in the usual manner, full thickness grafts sutured over the mould and the mould replaced. After the usual period, the sutures were cut, the mould released and a successful graft found beneath, as shown in Fig 6.

In addition to the cases mentioned above, there were two more belonging to this series, both of which presented ulcers resulting from X-ray burns, and, while they are not described in detail, the results obtained from the employment of this method of treatment were equally pleasing in each instance.

No particular originality is claimed for this method of skin-grafting, but the uniform success which has attended its use seemed to justify us in bringing it to the attention of the profession in the somewhat lengthy and explicit manner that we have, since the involved surface in each case was covered by an epithelium flexible and normal even to the extent that hair continued to grow when the graft implanted was thicker than that ordinarily used.

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THE SERUM TREATMENT OF ANTHRAX SEPTICÆMIA

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THE experience of recent years indicates that we must relinquish certain conceptions that have been bequeathed to us concerning the therapy of anthrax in man. It is now known that the pustule of cutaneous anthrax frequently heals spontaneously if it is left to its own devices and not subjected to operation or cauterization, either of which may precipitate septicæmia. Anthrax septicæmia, on the other hand, is commonly regarded as a form of infection that is practically always fatal. As a matter of fact, of all the septicæmic diseases, it is the one with which we are best prepared to deal, namely, through the use of immune serum. The literature of medicine contains references to six cases of cutaneous anthrax with bacteriological proof of disseminated infection, in which recovery followed the intravenous use of anti-anthrax serum. A seventh is described in this paper. The same method of treatment would appear to be applicable to the septicæmic forms of pulmonary and intestinal anthrax, although I have not been able to find any reference to its employment in such cases.

In the first of two cases of anthrax septicæmia recorded by Bandi,¹ the patient was a cattleman, thirty years of age, who presented a pustule on the right forearm. The pustule was treated locally by means of the thermocautery, thirty-six hours after which the patient lapsed into coma, and bacteriological examination of the blood revealed innumerable anthrax bacilli. One hundred and fifty c.c. of anti-anthrax serum were injected intravenously, followed an hour later by an additional fifty c.c. The next day the condition of the pustule was noticeably improved; nevertheless it was thought advisable to administer another forty c.c. of serum. Bacteriological examination of the blood at this time failed to reveal anthrax bacilli; in other words, complete sterilization had been brought about within a period of forty-eight hours.

In a second case recorded by Bandi, the patient was a butcher and likewise presented an anthrax lesion on the forearm. Bacteriological examination showed anthrax bacilli to the number of about seven colonies to the cubic centimetre of blood. The patient was treated by a single intravenous injection of eighty c.c. of anti-anthrax serum and the subcutaneous injection of thirty c.c. Again, the blood became sterile within forty-eight hours, and recovery ensued.

In the case recorded by Graham and Detweiler,² the patient was a tanner, thirty-six years of age, with an anthrax pustule on the left side of the neck. Forty-eight hours after infection, forty c.c. of anti-anthrax serum were given subcutaneously and the tissues surrounding the sloughing area were injected

with forty per cent. alcohol. The next day the lesion was excised, after which the patient became worse, and forty-eight hours later bacteriological examination of the blood showed the presence of anthrax bacilli. The patient was given one hundred c.c. of chloramin-T, together with eighty c.c. of anti-anthrax serum intravenously. The blood became sterile in thirty hours and remained so in spite of the fact that no further specific treatment was used.

In the case of Baduel and Daddi,³ the patient was a woman, thirty years of age, who presented an anthrax pustule on the right forearm. At the moment of admission to the hospital a blood culture was made and, at the end of twenty-four hours, revealed numbers of colonies of anthrax bacilli, an emulsion of which, injected into a guinea-pig, produced death in thirty-six hours with the typical lesions of anthrax. In the course of five days the patient was given a total of two hundred c.c. of anti-anthrax serum intravenously, at the end of which time the blood culture was sterile. The patient made an uninterrupted recovery.

In a case reported by Bissel,⁴ the patient was a longshoreman, fifty-four years of age, with a pustule on the right side of the neck. A blood culture taken twelve hours after admission to the hospital was positive. Intravenous serum therapy was commenced at the same time that the blood culture was taken and, during a period of forty-eight hours, one hundred and fifty c.c. of serum were injected intravenously in fifty c.c. doses. At the end of this time the blood culture was negative and the patient recovered.

In Becker's case,⁵ there was an anthrax pustule on the left eyelid. Blood cultures were positive. Treatment was commenced late because no serum was immediately available and, although the patient showed severe constitutional symptoms with high fever, the intravenous injection of serum was followed by sterilization of the blood and recovery. The amount of serum used and its method of injection are not given.

BELLEVUE HOSPITAL CASE

A man, aged thirty-five, was recently admitted to the service of Dr. William C. Lusk at Bellevue Hospital on a Tuesday evening with an anthrax pustule on the left side of the neck. The central eschar measured one and one-half by one cm. It was slightly depressed and was surrounded by a broad elevated rim that was covered by innumerable minute silvery vesicles. The tissues in the vicinity were swollen in an upward direction as far as the level of the external auditory meatus and downward to a point slightly below the left clavicle. At the time of the patient's admission to the hospital and throughout the length of his stay, he was mentally clear and showed no apprehension beyond that of a natural desire to be informed of the nature of his illness and the probable chances of death. The patient stated that on the Saturday before he had used a new shaving brush for which he had paid fifty cents. He had no recollection of having cut himself in shaving nor was he aware that his skin immediately previously had been the seat of an excoriation of

any sort. Within forty-eight hours, a small itching papule appeared on the left side of the neck. The papule rapidly enlarged and broke down, and the tissues in the vicinity commenced to swell and soon reached such proportions that he consulted a physician, Dr. F. F. Schirck, who sent him to Bellevue Hospital with the diagnosis of probable anthrax.

At the moment of the patient's admission, smears from the pustule showed numbers of gram-positive bacilli having the morphological characteristics of *b. anthracis*. Agar plates inoculated directly from the pustule revealed, after twelve hours' incubation, numbers of colonies presenting the typical doll's hair arrangement of the anthrax bacillus. Blood withdrawn from the median basilic vein and inoculated into three agar plates yielded, after twelve hours' incubation, an average of forty anthrax colonies to each plate. Three bouillon cultures were similarly positive. An emulsion of one of the colonies from a blood agar plate was injected into the subcutaneous tissues of the abdominal wall of a guinea-pig and in forty-eight hours the pig died. Necropsy showed gelatinous infiltration of the superficial structures of the thoracic and abdominal walls with areas of hemorrhage and necrosis in the track of the needle, and anthrax bacilli were grown in pure culture from the heart's blood. A second guinea-pig, inoculated with a few drops of one of the broth cultures, came down in forty-eight hours with practically identical changes, and anthrax bacilli were likewise cultivated from the heart.

The shaving brush that the patient had used was examined bacteriologically. Numerous colonies of anthrax bacilli were grown from the bristles, which consisted of horse-hair. One of my assistants, Dr. D. W. Cady, went to the shop from which the patient stated that he had purchased the brush, and the proprietor presented him with the entire remaining supply, nine in number. These were submitted to bacteriological examination, and virulent anthrax bacilli were cultivated from three of them and from the dust of the paste-board box in which they were kept, the virulence of each strain being determined by guinea-pig inoculation.

Immediately upon entering the hospital, the patient was placed in bed and fifteen c.c. of anti-anthrax serum were injected at several points under the skin in close proximity to the crater of the pustule as advocated by Regan. The next morning, when the blood cultures were found to contain anthrax bacilli, two hundred c.c. of anti-anthrax serum were injected intravenously. The dose was repeated at four-hour intervals on three occasions, making a total of eight hundred c.c. of serum to be administered within the first sixteen hours of treatment. The following morning blood cultures were made on six agar plates and, twenty-four hours later, every one of the plates was sterile. In the meanwhile, pending the result of the blood examination, the patient received an additional three hundred c.c. of serum intravenously in doses of one hundred c.c. every four hours, thus making a total of eleven hundred c.c. in forty hours' time. On the sixth day of the disease, examination of smears from the pustule failed to reveal the presence of

anthrax bacilli, and local treatment was discontinued. The patient was discharged from the hospital on the ninth day cured.

COMMENT.—This is the only occasion that I have had to treat a case of anthrax septicæmia, my previous opportunities having been limited to the serum treatment of some thirty odd cases of cutaneous anthrax without generalized infection. In order to meet a desperate situation, I deemed it best to employ large amounts of serum. Doses such as were used are recommended by no less an authority than Doctor Eichorn.⁶ Nevertheless, as a result of this experience and in reviewing the work of others who have been called on to act in similar circumstances, it seems to me that a preliminary intravenous dose of one hundred and fifty or two hundred c.c. of serum, followed by forty c.c. at four or eight-hour intervals, would probably suffice, and, in future, this, I think, is the plan that I should pursue as offering an equally reasonable chance of success. If limited to a given amount of serum, the first or "sterilizing" dose is the one on which I should be inclined to place the greatest degree of reliance. In spite of the favorable results reported by others from the use of relatively small doses of serum, it would appear that to depend upon the lesser quantities as a routine measure is sooner or later to court disaster—in dealing with a disease so treacherous as anthrax, it is well to leave a wide margin of safety.

The localized cutaneous lesion of anthrax, when fully developed, presents an appearance scarcely to be mistaken for that of any other disease. It is an ugly affair to look upon, painless, and possessed of vicious potentialities. It is characterized by a dirty brownish eschar, scattered over and surrounding which are numbers of pinhead-sized silvery vesicles, the whole set in the midst of an area of swelling which may remain within moderate bounds or assume such enormous proportions that, when the pustule is situated on the face or neck, the eyelids are closed and the tissues of the upper part of the chest are thrown into large œdematous folds. The swelling is due to the presence of a semi-gelatinous substance—anthraco-mucin—which is inimical to the growth of the anthrax bacillus and which represents, therefore, a defense reaction on the part of the tissues, and should be left alone.

While the anthrax pustule itself offers a forbidding aspect, the appearance of the patient, on the contrary, is apt to give one the impression of extraordinary tranquillity, *even though his blood may be swarming with anthrax bacilli*. For this reason, the only really justifiable attitude for the physician to assume is that every anthrax pustule from the outset is attended by the dissemination of bacilli in the blood, and to treat the patient on this assumption until the result of the blood culture is known. It is, at best, an error on the safe side. In artificial culture media the anthrax bacillus grows with facility and positive cultures may be sometimes secured within twelve hours, always within twenty-four hours. A negative result in twelve hours should never be accepted; a negative result in twenty-four hours need never be rejected.

In the meanwhile, the administration of serum is a harmless procedure and, in the event that anthrax septicæmia exists, valuable time will have been saved.

CONCLUSIONS

1. Every anthrax lesion of the skin or elsewhere should be tentatively regarded as attended by generalized infection until the result of the blood culture proves the contrary.

2. In no circumstances is it justifiable to tamper with the anthrax pustule—incision, excision, cauterization, or similar treatment is dangerous, and may be followed by anthrax septicæmia. The only permissible form of local treatment consists in the injection at the periphery of the pustule of broken doses of anti-anthrax serum at intervals of four or six hours, each injection not to exceed a total of ten or fifteen c.c. Failing this, it is better to cover the lesion with a bit of sterile gauze to collect the secretions, but otherwise to leave it absolutely alone.

3. The most dependable routine method in the treatment of the anthrax pustule is, first, to isolate it within a barrier of anti-anthrax serum subcutaneously injected every four hours; second, to inject intravenously, at once, a sterilizing dose of one hundred and fifty or two hundred c.c. of serum, and, third, to supplement this by the intravenous injection of forty c.c. every four or eight hours. If the blood culture is negative at the end of twenty-four hours, the intravenous use of serum may be discontinued, the local injections being kept up until the pustule is free from bacilli, or at least until involution forms occur in the stained films. In anthrax septicæmia, the liberal use of anti-anthrax serum intravenously, if commenced in time, is capable in many instances of sterilizing the blood with astonishing rapidity, and, in septicæmic cases, the routine just outlined may be followed until the blood cultures are negative.

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PERITONITIS AS A COMPLICATION OF PROSTATECTOMY

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INFECTIONS in relation to prostatectomy are of major importance and have well merited the attention given them in attaining the present satisfactory status of the operation. The average prostatic is usually a poor subject to withstand even a low grade infection, which is often supplemental to an already existing one. The most important infections are suppuration in the prevesical space and pyelonephritis. The former has been uniformly quite well handled by careful attention to drainage of this space. Pyelonephritis is often already present, but the occurrence of acute exacerbations may be minimized by gradual rather than abrupt relief of the back pressure produced by the obstruction and by giving plenty of fluids after drainage has been established.

Among the rarer complications of an infectious nature are phlebitis and epididymitis. It is highly probable that phlebitis with resulting emboli in the lungs is not so rare as we have believed it to be. Cabot recently demonstrated a case of osteomyelitis of the pubic bone following prostatectomy and stated that he had seen others. Peritonitis, however, is rarely mentioned as a complication of prostatectomy. In fact, most surgeons have considered the accidental opening of the peritoneal cavity during prostatectomy to be devoid of danger. Judd,¹ in 1913, made the statement that he had opened the peritoneum unintentionally on seven occasions with no ill effects. Pilcher² says: "This accident has occurred to the writer, but no untoward symptoms follow the injury if the wound is immediately closed." I, too, am able to state that this accident has happened to me several times and would formerly have agreed that it apparently was never followed by infection of the peritoneal cavity. In a casual survey of prostatic literature of the past several years no case of peritonitis following this accident has been found recorded.* That it may occur is demonstrated by the following case:

H. W. C., aged fifty-seven, farmer, was first seen January 27, 1920, and presented the usual symptoms of prostatic obstruction. Rectal examination revealed a moderately enlarged prostate. The patient was catheterized and three ounces of residual urine obtained. The blood-pressure was 150-90. Phenolsulphonephthalein test, first hour twenty

* An article has since been found by Deaver (Arch. Surg., March, 1921) giving the cause of death in thirty-six cases at the Lankenau Hospital. Three of these deaths were due to peritonitis.

per cent.; second hour five per cent. Cystoscopic examination was attempted the next day but nothing could be distinguished on account of the bleeding produced by the manipulations. Three days later a suprapubic cystostomy was done under local anæsthesia. The prostate showed moderate enlargement with a marked hypertrophy of the median lobe. After allowing the bladder to drain for three weeks it was decided to proceed with the second stage. The operation was begun as usual with local anæsthesia. While enlarging the suprapubic opening the peritoneal cavity was opened accidentally. It was closed in the usual manner. A small amount of ether was given and the prostate shelled out. The prostatic bed was packed with gauze, a drainage tube placed in the bladder, and the wound closed. The pathological diagnosis was adenoma of the prostate. The following day the patient's condition was good. On the second day, however, the patient began to have some abdominal distress and distention which increased progressively until death occurred on the fourth day with all the usual signs of an extensive acute peritonitis.

Permission for a partial autopsy was obtained. A very extensive peritonitis was found. The intestines were distended. There was a plastic exudate everywhere extending up to the region of the stomach. In the left lower abdomen, walled off by the sigmoid, was an abscess holding about one ounce of pus. The liver was somewhat larger than normal and from gross appearance there was evidently a beginning cirrhosis. The spleen was twice the normal size and an old encapsulated abscess the size of a hen's egg was found in it. The wall of the abscess was calcareous. The spleen itself was softer than normal. The kidneys and ureters were negative. The bladder wall was covered over about one-third of its surface by a diphtheroid membrane. The cause of death was an acute generalized peritonitis due probably to soiling of the peritoneum following its accidental opening in enlarging the suprapubic wound. It is to be regretted that no cultures were made and we are unable to report on the bacteriology of the peritonitis.

Although this occurrence must be extremely rare, it would seem well to bear it in mind. Measures directed towards its prevention would be (1) those aiming to prevent opening of the peritoneum and (2) those aiming to prevent soiling of the wound by bladder contents. If the operation is done by the two-stage method, there is probably more danger of the accident occurring at the time of the second stage.

The technic of the preliminary cystostomy varies greatly with different operators. The majority probably prefer irrigation and distention of the bladder with some sterile fluid. The peritoneal reflection is, of course, carried higher up on the bladder and is more easily avoided. After exposure and recognition of the bladder the fluid may then be drained off through a catheter in the urethra which has been allowed to remain in place, or by direct trocar puncture of the bladder. Wound soiling is readily avoided by either of these methods. Judd prefers a relatively empty bladder and sponges

out any small amount of urine that may be present. This method is quite satisfactory and it is hardly more difficult technically than to open a distended bladder. We do not have our patients catheterized before going to the operating room and the bladder usually contains a moderate amount of urine. A small opening is made in the bladder and the knife followed in by a finely perforated tubular aspirator connected to an electric suction apparatus and the bladder is readily emptied without wound soiling. We have had no serious infections of the space of Retzius using this technic. The space is always drained in the usual manner. Whatever method is used, one essential factor in the prevention of infections, whether of the space of Retzius or of the peritoneal cavity, is to prevent flooding of the wound with bladder contents, even if it has been irrigated and filled with some sterile solution.

It is in enlarging the bladder opening at the second stage that the greatest danger of opening the peritoneum presents. If the prostate is shelled out by touch without exposing it there is little danger of this accident, as a very small incision extending downward from the old sinus is usually all that is necessary. However, many men prefer the method of exposing the prostate by a larger bladder opening and the use of retractors. The operative field may be clearly viewed, which is often a decided advantage, and certainly comes within the range of good surgical principles. The bladder opening must be kept well away from the trigone and for this reason it is well to open the bladder as high up toward the fundus as is possible at the first stage, even if the primary opening into the bladder must be closed and a second one made. When this is done a generous bladder incision may be made at the second stage without cutting upwards from the old sinus and at the same time without encroaching on the trigone. It has been repeatedly pointed out that it is unsafe to make an incision upwards from the site of the fistula, and Deaver has recently made the flat statement that the opening should never be enlarged upwards.

When the peritoneum is opened accidentally it is sutured with catgut. But when such is done, and even in cases where there has been no peritoneal injury, it is well to look at the peritoneum after shelling out the prostate, if in the field, as it may be torn during the manipulation of enucleation.

Recently we have been dissecting the peritoneal fold well off the fundus of the bladder at the first stage and anchoring it there with one or two fine catgut sutures. Schmidt puts anchor sutures at the upper angle of the bladder incision placed as high as possible and then passes them through muscle, fascia and skin, thus preventing the peritoneal fold from herniating downward, especially as he does not separate the various layers laterally in exposing the bladder. The method of anchoring the fold back on the bladder has been done in too few cases to express an opinion as to its utility. The method described by Schmidt, however, would seem to be quite satisfactory. In dealing with badly infected bladders, Williams³ does a "three-stage" operation. The cystostomy is done in two stages. The first procedure

involves only exposing the bladder and placing guy sutures. He then waits four to seven days to permit walling off of the space of Retzius and paravesical tissues. The bladder is then opened and drained. The procedure is analogous to the usual one in doing a colostomy and would seem to be a very efficient method of handling badly infected bladders.

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SCIATIC HERNIA *

REPORT OF A CASE COMPLICATED WITH MYXOMATOUS TUMOR OF THE SCROTUM

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SINCE the publication of the classical article of Garré¹ in 1892, and that of A. Schwab² in the same year, this type of hernia has been recognized as one with three forms " . . . which pass out both posterior sciatic notches, the greater sciatic notch and the lesser sciatic notch. Anatomically, it is possible for a pushing out of the peritoneum in three places. The greater ischiatic notch is covered by the pyriformis muscle which has a small opening or split both at its upper and lower borders. The superior gluteal artery passes out regularly through the upper opening accompanied by a small similar named nerve, while through the lower opening pass the internal pudic artery and commonly also the principal branch of the ischiaticus (Fig. 1.) Hernias can occur through both openings. The third place in which a hernia can occur is through the smaller ischiatic fossa. In all cases, through whichever opening the hernia passes, it must always have the great or posterior sacro-sciatic ligament (ligamentum tuberoso-sacrum) under it. After passing through one of these openings it makes its appearance in the gluteal fold, under the border of the gluteus maximus muscle. To differentiate a sciatic hernia from a perineal hernia the examining finger can always feel the sacrosiatic ligament above the hernial opening in a perineal hernia; below, in a sciatic form." Garré compares the great sacrosiatic ligament, in this differentiation, with Poupart's ligament in distinguishing between femoral and inguinal hernia. Although it is generally credited to Sir Astley Cooper³ as having been the first surgeon to describe a case of ischiatic hernia observed in 1800 (Figs. 2 and 3), a further examination of the literature brings out the fact that an earlier case was reported in 1750 by a German author of the name of Papen, in a letter addressed to Haller. We learn from Schwab, whose paper represents the most exhaustive study of the subject of ischiatic hernia in the literature, as far as I have been able to study the references, that the etiology of ischiatic hernia is obscure—probably chiefly because of the rarity of its occurrence. There is a marked predominance in the female sex in proportion to two cases in women to one case in men. This greater frequency is explained by the fact that the ischiatic notch is slightly larger, as well as that the sacrosiatic ligament in women is of greater length and laxity. The hernia occurs more frequently on the right side than on the left, having been observed there ten times out of fourteen cases. One particularly interesting case of a woman, reported by Crosslé,⁴ has a clear history as to its etiology, it having developed while the woman was "in the act of stooping

* Read before the Western Surgical Association, December 9, 1921.

and assisting to lift a heavy iron plow into a cart; she became suddenly conscious that something had given way in a situation deeply seated," where she later discovered a small tumor about the size of a pigeon's egg, situated on the margin of the gluteal fold on the same side. This tumor gradually increased in size until when it was examined by Crosslé it had reached the size of a well-formed foetal head at full period. A drawing (Fig. 4) made of this tumor and published in the reports of the Dublin Pathological Society, in every respect had the appearing characteristics of an ischiatic hernia, and has served as an illustration of ischiatic hernia, in text-book articles on the subject since Crosslé made his report.

Ischiatic hernia is congenital or acquired, never congenital in women, and is most frequently caused in women as a result of the pressure and trauma of labor. The hernia can occur on either side—right or left—and can contain intestine and omentum and any viscus or organ sufficiently movable to reach and pass out of the pelvic cavity. Of the cases reported by Garré, three contained the right ovary and a loop of intestine. Von Eiselsberg⁵ reports a case of cut-off (*abgeschnürter*) intestine as a content of an ischiatic hernia, operated May 19, 1904. The patient—a child—was a boy one and a half years old. There was a swelling about egg-sized, in the left sacral region. Three days before taking the boy to the Clinic the swelling had spontaneously enlarged. The tumor was diagnosed as a lipoma, which it was in part. Operation disclosed the swelling to be a lipoma below, and an ischiatic hernia above, involving the foramen ischiaticum majus. The contents of the sac were a convolution of intestine having two blind, sausage-shaped ends (Fig. 5), and only communicated with the peritoneal cavity by a little finger-sized mesentery pedicle. The pedicle was ligated and divided, and the intestinal coil removed. (Fig. 6.) The patient recovered.

The hernia may be very small and not perceptible to sight, or it may be large. It may vary in size from that of a chicken's egg to that of a grape-fruit. Such a tumor may be mistaken for a teratoma, lipoma, or spina bifida.

Out of the seventeen cases reported up to the time of the articles by Garré and Schwab in 1892, eleven of them can be positively stated as being true ischiatic hernia; since that time a few isolated cases have been reported by British and Continental surgeons, and the sum total to-day equals about twenty-five. As far as the available literature at my disposal is concerned, I have been unable to discover a single case reported by an American surgeon. Doubtless, cases have been observed and possibly reported.

From the comparatively small number of cases which have been reported, it appears that these hernias, unless they produce symptoms of strangulation, had best be let alone. When from the size of the hernia the symptoms warrant interference, an attempt may be made to close the hernial opening from without. In the presence of strangulation a combined operation (extra- and intra-pelvic) should be performed, and the case dealt with on general surgical principles. M. Köppl has noted nine cases of strangulation out of the twenty-

five cases published in the literature. Lejars^o recommends as a technic for operation, first, that an excellent light must be provided because of the deep situation of the hernial ring, and the necessity of avoiding the wounding of important blood-vessels, which might lead to a fatal termination, and which the methods of exposure, never quite satisfactory, might not suffice to prevent. The incision should be made in a downward and outward direction because the gluteal artery usually crosses the superior border of the sac; this is true only in a certain number of cases, but one can never know in advance the exact type of the hernia. A large incision should be made through the gluteus maximus, and its two flaps retracted in order to expose the subjacent region. The incision should be made obliquely, following the direction of the muscular fibres, from the posterior inferior spine of the ileum to the lower posterior border of the great trochanter. It is the same incision as that employed for the ligation of the gluteal artery, only it is made one or two finger-breadths lower. Under the gluteus maximus the sac must be carefully isolated before opening it, and the operator must endeavor to recognize by feeling with his finger, above, the osseous arch of the great sacrosciatic notch; below, the superior border of the pyramidalis muscle, which obliquely crosses this deeply exposed region. The sac is then incised and the finger, passing up the neck, enlarges the opening by making gentle pressure downwards and outwards. In any necessary further enlargement of the hernial opening great care must be taken not to injure any of the neighboring arteries. The contents and the sac should be dealt with as in other hernias, and an attempt made to close the opening with the available tissues in the most practical way possible. Should gangrene have already developed, after establishing external drainage the operation should be completed, most safely probably at a later period, by the abdominal route, in the same fashion as it would be carried out in a similar complication of one of the ordinary hernias.

The subject of my observation (Fig. 7) was a man, age thirty-five, iron-worker, white. Entered my service in the University of Nebraska Hospital (surgical number 6213), June 17, 1921, for the removal of a large heavy scrotal tumor reaching well towards the knees. This had had its beginning three years back, growing slowly at first, of late, rapidly. Three years previously the patient had been operated upon for an appendiceal abscess—the appendix was not removed. Two months following this operation the patient noticed some bulging in the right gluteal fold; later, an unsuccessful attempt was made to remove the appendix, and a scar of an incision over the bulging, replaceable swelling in the right gluteal fold, indicated that an attempt at exploration had been made, but the man was ignorant as to this. The patient had a right inguinal hernia near the middle line which was the incision used for the drainage of the appendiceal abscess, and a palpable, intra-abdominal tumor could be felt suprapubically. The swelling in the right gluteal fold had increased considerably in size in the last year. The past and family history of this man was negative, except for the fact that he had been given to the excessive use of alcoholic drinks. All physical findings were negative except as above stated. Wassermann and other laboratory findings were negative. The large, massive scrotum was larger on the right side than on the left. The testicles were in their

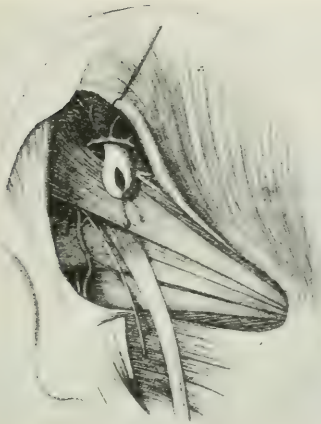


FIG. 1.—Showing a hernia passing out at the upper border of the pyriformis muscle, and its relationship to the gluteal artery and nerve.

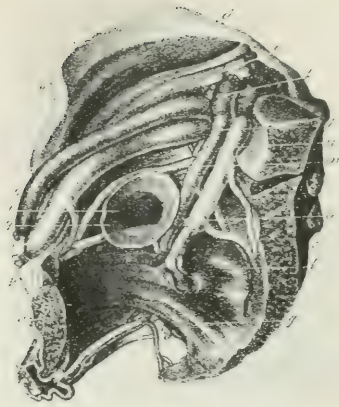


FIG. 2.—(Cooper) Internal view of ischiatic hernia. (a) Section of the pubis; (b) Spinous process of the ilium; (c) Sacrum; (d) Iliacus internus muscle; (e) Psoas muscle; (f) Pyriformis muscle; (g) Coccygeus muscle; (h) Termination of the external iliac artery in the crural; (i) Beginning of the crural vein; (k) Trunk of the common iliac artery; (l) Internal iliac artery; (m) Obturator artery, which may be traced before the sac as far as the obturator foramen; (n) Internal iliac vein; (o) Obturator vein passing behind the hernia to the obturator foramen; from which another vein (p) is seen passing into the iliac vein; (q) Hernial sac; (r) Its orifice.

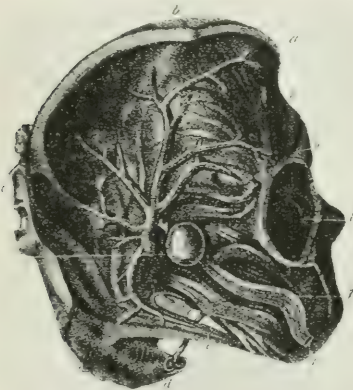


FIG. 3.—(Cooper) Posterior view of ischiatic hernia. (a) Anterior superior process of the ilium; (b) Crista of the ilium; (c) Sacrum; (d) Os coccygis; (e) One of the sacro sciatic ligaments; (f) Acetabulum; (g, g.) Sciatic nerve; (h) Gluteal artery; (i) Ischiatic hernia sac situated between the artery and nerve.

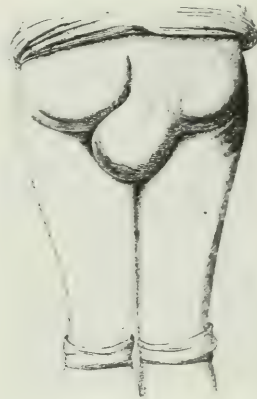


FIG. 4.—Drawing of case reported by Crosslé.



FIG. 5.—(von Eiselsberg)

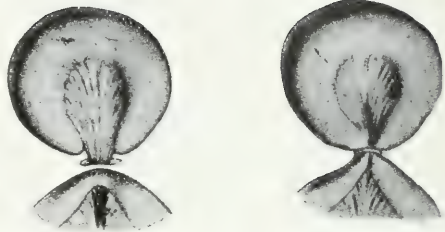


FIG. 6.—Probable method of restoration of intestinal current. (von Eiselsberg.)

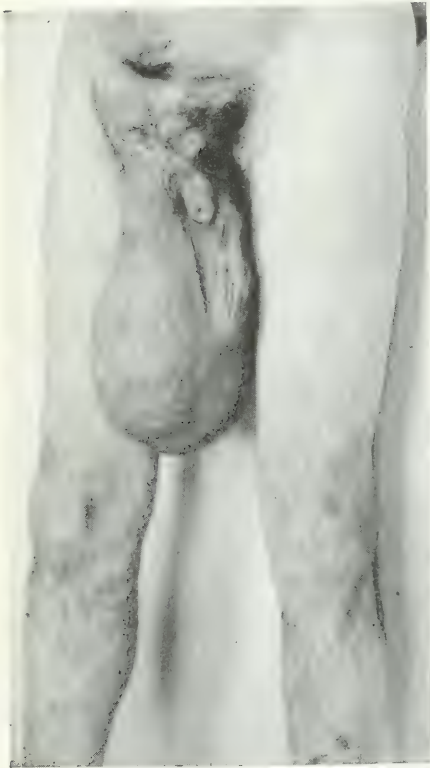


FIG. 7.—The scrotal tumor—myxoma.



FIG. 8.—Right ischiatic hernia. Myxomatous tumor of scrotum.



Fig. 9.—Showing appearance after removal of scrotal tumor.

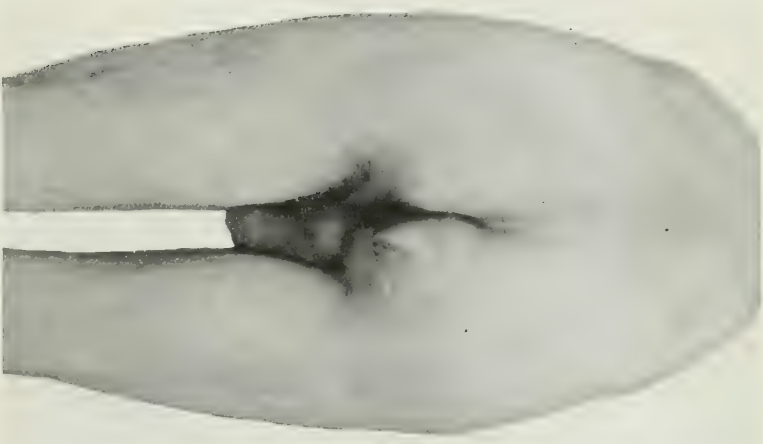


Fig. 10.—Showing perineal tumor which appeared post-operatively.

normal position and the tunicae vaginales were evidently not involved. The gluteal tumor, the size of a medium adult fist, presenting at the gluteal fold, disappeared upon the patient's lying down with the pelvis elevated; it was resonant upon percussion; gave an impulse upon coughing; gurgling could be felt; it was replaceable and passed within the pelvis above the great sacrosciatic ligament. In other words, it had all the characteristic phenomena of a true ischiatic hernia. As this hernia was making no special disturbance, and as it was easily reduced, operation was not deemed advisable because of the other complicating conditions, referable to the scrotal tumor. The scrotal tumor had, to my mind, the external and physical characteristics which we recognize as elephantiasis.

On the twelfth day after admission into the hospital, under ether narcosis, the patient was operated upon for the removal of the scrotal tumor, which was heavy and quite vascular, flaps being formed as deemed best to restore the parts to an approximately normal state. (Fig. 9.) An unusual condition was discovered in the carrying out of this technic, which was not easy; the tumor had a pedicle of about half the size of the ordinary man's wrist, which passed up in the perineum between the rectum and the urethra and was a part of the pelvic tumor, which was palpable supra-pubically, extending upwards about one-quarter of the way towards the umbilicus. The gross tissues of the tumor, which was heavy and had many blood-vessels coursing through, had much the appearance of the thick, whitish, watery tissues of the scrotum, seen upon incision into it in instances of extravasation of urine. The wounds healed kindly and X-ray treatments were instituted for their hoped-for influence upon the remaining portions of the tumor in the pelvis. The patient was discharged from the hospital July 23, 1921, with orders to report as directed, for observations and X-ray treatment. The man renewed his alcoholic habits and was unreliable and neglectful in carrying out instructions, and, being interested, I had him practically kidnapped when drunk and brought to the hospital for further treatment, as it had been ascertained that the tumor, both perineal (Fig. 10) and pelvic, was enlarging very noticeably. He reentered the hospital September 4, 1921, and it was not until September 19th that he had sufficiently recovered from the effects of his alcoholic poisoning to justify an operative procedure under ether. On this day I removed a considerable mass of the new growth which had mounted upwards from the perineum towards the right inguinal ring. The incisions employed gave me an opportunity to determine that the pelvic growth was a retroperitoneal one.

The hospital pathologist, Doctor J. J. Keegan, reports as follows:

"In gross the tumor consisted of numerous encapsulated nodules, two to ten centimetres in diameter, of moist, translucent, fairly soft tissue. The form was preserved on section. Microscopically this tissue consisted of widely separated spindle and star-shaped cells with processes anastomosing or disappearing in the matrix. These cells were more numerous in the region of the capsule and about blood-vessels. There were varying numbers of blood-vessels with loose mesh adventitia. The matrix of the tumor consisted, in formalin fixed tissue, of a finely fibrillary structure and clear interspaces. A diagnosis of myxoma was made in this case on account of its distinct nodular tumor characteristics, its tendency to recur after operation, and the loose-mesh embryonic connective-tissue characteristic on section."

The particular interest in this scrotal tumor consists in the fact that its growth downwards, and upwards into the pelvis, follows the embryonic development of the scrotum itself. The myxomatous character of the tumor confirms its mesodermal origin. The scrotum is mesodermal in origin, and like the abdominal wall differentiates into the same layers. The best description of the embryological development of the scrotum with which I am familiar will be found in the Treatise on

Surgery⁷ by le Dentu and Pierre Delbet. The formation of the scrotum is independent of the testicular development and migration. "At the beginning of embryonic life the terminal portion of the intestine, the allantois, the canal of Wolff, and the canal of Müller, open into a common cavity which bears the name of cloaca. Towards the second month a mesodermic bud (or shoot) is detached from the superior wall of this cavity, which, under the name of perineal spur descends vertically and forms a transverse partition; this divides the cloaca into two cells, henceforth separate and independent. The posterior cell is called the anus; it is in its interior that the intestine ends. The anterior cell bears the name of urogenital sinus." From this, later, develop the urethra, and in the female the labia of the vulva, in the male the scrotum.

I now have this patient, because of his habits, under legal restraint, and under my control, and am having the X-ray treatment carried out systematically, and hope to be able to report at some future time the disappearance of the pelvic, myxomatous tumor, which I am advised by radiologists should be considered as a tumor favorable to such treatment because of its unlikelihood of metastasizing.

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SPONTANEOUS LATERAL VENTRAL HERNIA*

BY JACKSON K. HOLLOWAY, M.D.

OF PHILADELPHIA

IN presenting this study it is not my intention to claim any originality. The subject of hernia in all its forms has been reviewed repeatedly. Hernia in its many varieties forms a large part of early and modern surgical literature. Gradually the classification into types offered particular subjects for the investigators. Little remains now to be added. Lateral ventral hernia, spontaneous or traumatic, has been written about frequently and fully. Yet the occurrence of a spontaneous ventral hernia offers interest, for because of its rarity it is frequently not diagnosed before strangulation occurs, or until exploratory laparotomy reveals it to be the incipient factor in the production of a series of aggravating symptoms.

Accordingly then it shall be my purpose to report one more case of such a hernia, to review briefly the subject and to point out a few diagnostic difficulties which have been little considered and less admitted.

Definition.—The definition of La Chausse is that “ventral hernia is any hernia except a femoral, inguinal or umbilical.” He included parainguinal, medial inguinal and supravescical hernia in his classification, and added, “No certain locus can be assigned to them.” Mollière wrote that “nearly always these herniæ occur in the linea alba, or a little outside this cicatrix, or in the semilunar line of Spiegel, and on a level with a line from the anterior superior spine of the ilium to the umbilicus.” Obviously any hernia of the anterior abdominal wall would be a true ventral hernia. Excluding umbilical, lumbar, and post-operative or traumatic types, we may define spontaneous ventral hernia as one which appears at an abnormal opening in the abdominal wall, apparently without explicable reason, but usually presenting in or near the linea alba, or the semilunar line of Spiegel. Our present interest, however, being in lateral ventral hernia, this discussion will be limited to that type of hernia which occurs near the lateral margins of the recti muscles, in that aponeurotic structure commonly known as the semilunar line of Spiegel. More strictly speaking, however, this is not a mere line, for repeated dissections have proved that the blending of muscle layers and ensuing aponeurotic sheaths may not be accomplished through a sudden sharp line of demarcation, and that consequently the so-called Spiegel line may be a fairly broad structure extending a varying distance from the lateral rectus margin. It is then, in this space, that such hernias as we shall discuss occur.

Report of Case.—K. H., widow, age forty-five, was admitted to the Episcopal Hospital, August 25, 1921, in Doctor Ashhurst's service. Family history was negative. She had had the ordinary diseases of

* Read by invitation at a meeting of the Philadelphia Academy of Surgery, February 6, 1922.

childhood and typhoid fever at twenty-four years of age. She had had four children. The menstrual history was negative. Her general health had been always good.

Chief Complaint.—Lump in right side. The patient noticed a small lump in lower right side two years ago soon after going to work in a mill where she had to lift heavy loads, sometimes seventy pounds, two or three times a day. The first time she noticed the lump she felt a "click." A month or so later she noticed a lump about the size of a small marble. This grew larger gradually, and became slightly painful. Several times, at various intervals, she noticed that the lump appeared, and she found that upon lying down it disappeared especially when a hot bag was applied to the region. Often the lump was sore to touch and she would be compelled to lie with her leg drawn up. Pain would be cramp-like, but seldom occasioned nausea or vomiting. Usually the lump would be reduced gradually, or as she put it, "by degrees." The site of this swelling was pointed out as being a little above and external to the inguinal region. It was a little larger on admission than when first noticed. It became painful when she exerted herself or sometimes when she would stand up. She had never had much difficulty in replacing it. Sometimes an interval of two weeks occurred without her noticing it. She had suffered constipation, indigestion, belching of gas and occasional vomiting spells for an indefinite time. Other systems were irrelevant.

Physical Examination.—The patient is a well-developed, well-nourished, but not obese, white adult female, forty-five years of age. The head, neck, chest and heart are negative. The abdomen is not pendulous. There are striæ over the lower wall (from previous pregnancies). There are no scars, no areas of tenderness or rigidity. The patient points out the site of the lump just above and to the outer side of the right inguinal canal. Repeated examination by manipulation, palpation, and observation failed to disclose any abnormality, the "lump" of which she complained remaining undiscovered as well as any depression or orifice in this region. The genitalia and extremities were negative. Basing the diagnosis strictly upon the patient's history, a diagnosis of hernia was made, though no classification was mentioned.

Operation.—August 30, 1921. (Doctor Ashhurst and Doctor Holloway.) Incision fifteen cm. long parallel to the fibres of the external oblique above and below the right anterior superior spine of the ilium, exposing the external oblique. The aponeurosis of the external oblique was opened, and beneath it a hernial sac was found the size of a hen's egg, covered with preperitoneal fat. The sac was dissected free, from an opening in the internal oblique and transversalis muscles; which opening was opposite the anterior superior spine, and at least eight cm. above and to the outer side of the internal ring. Sac opened at its fundus, and excised around its origin from parietal peritoneum. Appendix removed. Meso-appendix sutured for bleeding, stump ligated and buried. Wound then closed in layers with continuous chromic for the peritoneum, interrupted chromic for internal oblique

and transversalis as one layer, and continuous chromic for the external oblique and for the skin.

The patient made an uneventful recovery and was discharged sixteen days later. Six weeks after operation the patient reported to me for examination. She was in excellent health and spirits. Her symptoms of indigestion, belching and vomiting had disappeared. She no longer had any attacks of pain or abdominal discomfort. Her general mental attitude was greatly improved.

Historical.—History has it that Hippocrates, Avicenna and Galen were familiar with ventral hernia, but the early observers seem to have known only those traumatic in origin. Le Dran (1742) gave the first clear discussion of the subject in his *Traité des Operations de Chirurgie*. La Chausse, who gave the first accurate contribution upon the subject of ventral hernia (1746), states that Celsus devoted an entire chapter to the subject but confused it with umbilical hernia. It remained for Dionis, Garangeot and Heister (1738) to clearly differentiate them. La Chausse distinguished three types of ventral herniæ: (1) Those in the linea alba above and below the navel; (2) those in the lateral epigastric regions; and (3) those in the lateral hypogastric regions due to separations of the fibres of the oblique or transversalis muscles. In his studies of the last type, however, he considered those herniæ of traumatic origin only. In 1746 Klinklosch pointed out "Spiegel line herniæ," but in his study he included all types of abdominal hernia. In 1804 Cooper added much to the subject.

Little advance in the study of this particular type of hernia was made then until the latter part of the nineteenth century, and interest in cases assumed only the proportion of curiosity. In 1877 D. Mollière presented a case consecutive with phlegmon and this is accordingly ranked as traumatic in origin. In 1878 Terrier produced his important work upon ventral hernia and in 1879 Mackrocki assembled eighty-six cases of lateral abdominal herniæ, pointing out favorite sites as vascular exits added by fat. In 1881 Ferrand added his own case to his thesis.

The most elaborate studies seem to have been made within a comparatively recent time. In 1907 Thévenot and Gabourd brought the subject up to date. In 1910 Steimker, and in 1911 Baudoin produced excellent articles. Among many other writers who have studied the subject may be mentioned Gosselin, Belfinger, Graser and Duplay. The latest contribution, in which a most excellent review of the subject by Augé and Simon is achieved, appears in a recent issue of *Revue de Chirurgie* (1921, lix, 297). It is rather striking that apparently little consideration has been devoted to this particular type of hernia by American writers. Perhaps the excellent work by French, German and English writers has made it unnecessary.

Etiology.—Berger states that from a standpoint of production two sorts exist:

1. Under a cicatrix or a complete or incomplete rupture of the abdominal muscles. 2. Spontaneous.

The cicatricial type is that type which follows trauma to the abdominal wall which may or may not have broken the skin. This type being self-evident need not be further discussed here except to mention that in certain cases in which ventral hernia may follow trauma after several years have lapsed, the trauma may have been entirely secondary and incidental to the production of the hernia. Belfinger states that traumatic hernia must be completely developed immediately or within a few days after receipt of the injury and that there must have been no predisposition to hernia, no matter of what nature, thus no latent hernia, no empty hernial sac.

These herniæ are most frequently seen in women. Of twenty-nine cases of ventral hernia reviewed by Berger at the Central Bureau (France) there were twenty-three in women; twenty of these were spontaneous. Berger believes them most common in fat women about thirty years of age. Augé and Simon list twenty-seven women in a report of forty-seven cases, the youngest being twenty-five and the oldest seventy-two. The youngest male reported was one-half year, the oldest forty. These ages are apparently unimportant, however, for they relate only the age of the patient when seen by the surgeon. The date of origin would be more valuable. Unfortunately this is in most cases uncertain. Many of the patients, however, evidently had their herniæ a number of years before presenting themselves. The longest duration we have ascertained is sixteen years. It is evident that the origin may precede the descent of contents into the sac by an indefinite time.

Pathological Anatomy.—The site of these herniæ depends primarily upon a solution of continuity of tissues in the abdominal wall, and they are usually limited by the fibrous contour. Peritoneum stretching over a point of weakness finds its way outward forming a sac. Intra-abdominal pressure may be a deciding factor. Rupture of the "posterior fibres and sheath" is essential, says Berger.

Cooper showed that spontaneous ventral hernia usually presents along the line of Spiegel, and particularly at the "junction of the aponeurosis of the transversalis and posterior fibres of the sheath of the muscle." He was the first to point out (1804) that "blood-vessel openings through the abdominal wall" were frequent sites of ventral hernia. Mackrocki, Regnier and Brennan have expressed belief that at this level numerous "hiatus vasculo-nerveux" (which give perforating "anterior and external" vascular branches and nerves to the abdominal wall) are causative factors.

Ferrand, basing his opinion upon two dissections, states that below the umbilicus there are diastases between the aponeurotic fibres of the transversalis due doubtless to the projections of branches of the deep epigastric arteries which wind between the thin transversalis fascia and the posterior layer of the aponeurosis of the internal oblique. Cooper pointed out also that next these vessels the muscle may be lacking, predisposing to hernia, which, however, may pierce the transversalis at one point and penetrate the overlying area at some distant point. Graser called ventral herniæ outside Spiegel's line "seitlichen Bauchbruch" and believed them due to muscle defects or acquired

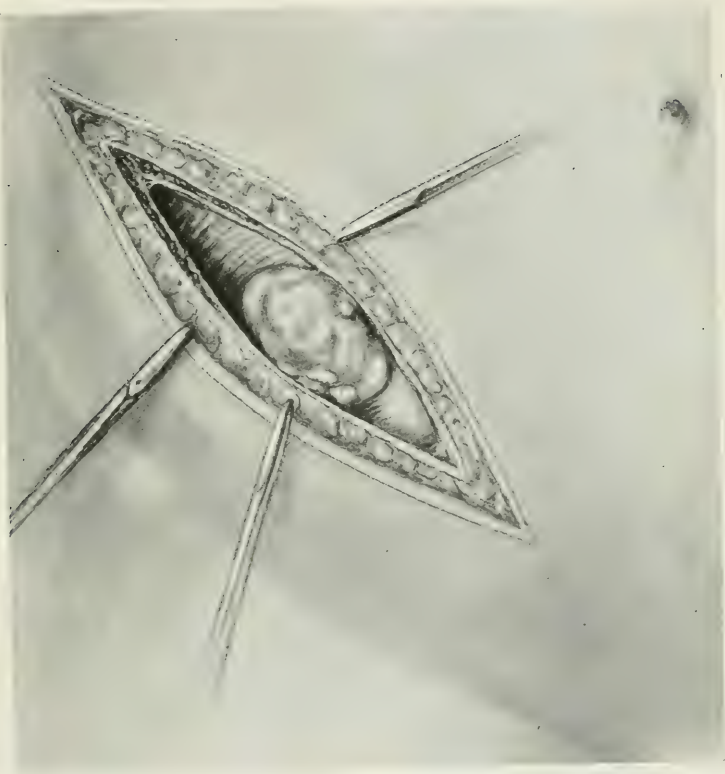


FIG. 1.—Lateral ventral hernia, presenting above and lateral to the internal inguinal ring. Sac exposed by an incision through the external oblique muscle and aponeurosis.

muscular paralysis. There may be arrest of muscular development. In such a case merely a fibrous membrane present in this portion of the abdominal wall. Phlegmon or abscess in the abdominal wall, as from the iliac crest, has been offered as a source of weakness. Platner held that hernia could pierce muscular parts by "separating muscular fibres," but Berger says it would be difficult to find an instance where a true spontaneous ventral hernia had a sac in which the neck was bounded by muscle tissue. B. Schmidt described a preformed peritoneal sac due to the drag of preperitoneal fat as a predisposing cause.

Le Dran pointed out repeated pregnancies as the most frequent cause. Augé and Simon have concluded that increased intra-abdominal pressure from any cause is primary and they quote Boyer (1822) as saying "of all causes most capable of pushing against the closed abdominal wall, the simultaneous contraction of the diaphragm and the abdominal muscles is most effectual." In vomiting, in labor, carrying burdens, expelling retained urine and accumulated feces, we most commonly find such conditions. Crushes, blows and falls on the abdomen are evidently to be considered. In such cases the trauma sustained may obscure the spontaneous origin of a preëxisting hernia or a sac.

Spiegel line herniæ are usually single. They may be multiple. Berger states that in one patient he saw two on the right side and one on the left, not symmetrically placed.

Diagnosis.—Many opinions are expressed as to the ease or difficulty of diagnosis. Some cases present with the diagnosis outstanding. The patient may have known the presence of an inconstant tumor mass in his side. These cases usually should present no difficulty, especially if the patient is thin, but often the diagnosis is merely presumptive. If the hernia can be seen or felt there is no difficulty. The interstitial type presents more difficulties, and authorities claim that these may defy detection. In our case no amount of effort or manipulation could cause a hernial protrusion. No depression could be located. Others have found the same difficulty. In the case of a patient who presents himself offering a history of having repeatedly seen a reducible swelling in a particular area, painful, causing digestive upsets, perhaps also vomiting and constipation, the diagnosis of a hernia is simple. Many patients have been operated upon without having the hernia discovered at all. In a fat person the hernia may be unreduced but effectually hidden in subcutaneous fatty tissue. A. Mouchet and R. Gouverneur present their case as an illustration of diagnostic difficulty. A soldier twenty-four years of age had received a kick in the abdomen just above the groin seven years previously. Sometime later a tumor was noticed by him about the size of a small nut in the region of the injury. It was painless and little noticeable, never causing trouble. An army physician examining him failed to notice it at all. Later, following a fall in a trench the hernia became larger and painful. Operation showed the hernia coming through all three muscles above and to the outer side of the internal ring and containing omentum. These writers believe that

TABLE I.

No.	Size and Site	Ring	Contents	Strangulation Diagnosed	Possible Etiology	Remarks
No. 1. M. 24. Mouchet & Gou- verneur, 1916	Pigeon egg para- inguinal next obl. & transversalis	Buttonhole	Omentum	Subacute, before operation	Kick in groin from horse 7 yrs. pre- viously	.....
No. 2. M. 20. Williamson, G. H. 1915	"Not large" above and to inner side int. ring	Tight fibrous band	Ten inches ileum	Subacute. Inguinal hernia	.....	Duration about 2 yrs.
No. 3. F. (). Jordan, F. 1883	Tender spot well outside ing. canal between umbil. and groin	.....	Flat sac with 8 inches bowel	48 hrs. before operation	.....	Previous health good. Diagnosed upon signs of obstruction. Gave signs of acute appen- dicitis and ureteral cal- culus. Recovered.
No. 4. M. 69. Teale, T. P. 1842	Left abd. wall be- tween umbilicus and iliac spine	Tendinous on me- sial side. Soft on lateral side.	Colon and ad- herent omen- tum	Before operation	.....	Died 12 hrs. after op. Colon intensely in- flamed.
No. 5. F. 25. Gosselin, 1881	Thinned out space between umb. and ant. sup. spine	.....	.....	Several attacks of subacute. Before operation	Coughing	Noticed only few days.
No. 6. M. 63. Terrier, 1878	Left border rectus above int. ring. Sac would admit tip of finger	Annular tightly constricted	2-3 cm. gut	After operation	.....	Six days of pain, occa- sional vomiting. No bowel movement, no flatus.
No. 7. M. 48. Robinson, B. 1914	Left side above ing. canal	Little finger	Knuckle small gut	Before operation	.....	Noticed 2 yrs. especially in winter when had bronchitis.
No. 8. M. 53. Coley, Wm. 1909	McBurney's point	7/8 inch diam., firm	Loop cæcum	Before operation	Horse fell on him 7 yrs. previously	Indefinite symptoms of pain in region of appen- dix shortly after acci- dent, lasting about 4 years.

SPONTANEOUS LATERAL VENTRAL HERNIA

No.	F.	38 by 34 cm. in 3 pockets	Level of umbilicus in left lat. abdom. wall all tight	Colon, cæcum appendix. Small gut, omentum. Partly adherent	In parts. sight	Upon	Lifting weights	Duration
No. 9.	F. Baudouin, 1911							Duration 6 years. Umb. orifice normal when examined. Recovered.
No. 10.	F. 44. Moller, H. 1919	Internal to iliac spine 4 cm. diam. midway to rectus border		Adherent omentum				Reducible tumor 15 yrs.
No. 11.	M. 72. Moller, H. 1919	Sac 7.8 cm. long to mesial side muscle fibres of left int. obl. and transversalis		Adherent omentum	Before operation			Operated 1908 for double ing. hernia.
No. 12.	F. 57. Macewen, John A. C. 1907	Sac 1½ in. long but very distensible midway vs. umb. and symph. in R. sem. line	Narrow	Empty when operated				Complained pain 2 yrs. prev. to op. complicated with small umb. hernia.
No. 13.	F. 80. Robinson, H. B. 1907	Rt. iliac fossa, above ing. canal		Adherent omentum	Signs of obstruction before operation			Symptoms 4 days. Found external to deep epigastric artery.
No. 14.	M. 25. Barthélemy, 1919	In rt. iliac region just above Douglas' fold			Before operation		Appeared suddenly while lifting heavy joist	Existed 2-3 mos. before op. Easily reducible.
No. 15.	F. 47. Watson, 1919	Between gall-bladder and appendix		Adherent omentum	Repeated attacks, subacute			Duration about 5 years.
No. 16.	M. 35. Brennan, 1899	Rt. semilunar line		Intestine and omentum			Appeared suddenly while at work	
No. 17.	F. 34. Holloway, 1921	8 cm. above and to outer side rt. ing. ring		Empty	No. At operation		Noticed first while lifting moderate weight	Duration about 2 years.

the hernia was not due to the kick but that it preëxisted as a congenital diverticulum of peritoneum; that the kick and fall merely contributed to its enlargement and strangulation.

S. Steimker found in the cadaver of a fifty-year-old man, with bilateral inguinal hernia and a supravescical hernia, also a defect in the abdominal wall six cm. horizontally and medially from the left anterior superior spine of the ilium; this was a round three cm. wide opening with a seven cm. deep sac protruding. This sac was embedded in the muscles of the abdominal wall. The medial boundary of the sac was the lateral margin of the left rectus. The lateral boundary was not clearly visible or palpable.

Steimker relates that in an unreported case of Braun in a male thirty-eight years of age, with symptoms of intestinal obstruction, coming to operation, a mass was discovered in the left lower quadrant of the abdominal wall. There was found a strangulated hernia in a sac of peritoneum with an opening the size of a mark piece (German coin) resembling the inguinal ring. (*Beit. z. klin. Chir.*, 1912, lxxxii, 633).

It is apparent then that these herniæ may exist for an indefinite time unobserved and absolutely without symptoms. The patient may recognize a disappearing painful tumor, but he usually does not understand its significance. He comes to the surgeon because he associates the tumor with a certain amount of pain, burning or tearing in his abdomen which hinders his work. Usually the tumor will disappear upon lying down.

Palpation may reveal merely a painful spot. Sometimes a tumor mass may be felt which upon pressure reduces with an audible gurgle; or the finger may locate an orifice.

If the patient leans forward the tumor may appear. Anything to increase intra-abdominal pressure may cause the hernia to protrude. Often, however, all efforts fail and a presumptive diagnosis is made only upon subjective symptoms.

These herniæ are especially liable to incarceration or strangulation. The extremely distensible sac with a very narrow neck and orifice favors such a result. Gangrene then supervenes rapidly. Most of the cases reported have been found to have been completely or partially strangulated at one time or other, sometimes several times. But even as such, they are sometimes not clearly defined. Cases are reported where acute appendicitis, pyelitis, and cholecystitis have been confusedly diagnosed. Inguinal hernia may be the pre-operative diagnosis. No diagnosis at all has preceded some operations where the symptoms of obstruction have led the surgeon to believe that exploratory laparotomy was necessary and justifiably so.

Treatment.—Operation offers the only hope of permanent cure. It is to be substituted by conservative treatment only in cases in which any operative procedure is contra-indicated. Operation consists in freely exposing the sac by incision, complete excision of the sac and obliteration of the orifice. The overlying structures are then to be closed in layers without necessarily overlapping the fascial or muscle plates. Symptomatic relief may be secured by

wearing a tight abdominal belt. In children with diastasis of the recti adhesive straps may be effectual as in umbilical hernia. Usually such treatment is merely palliative.

In cases where the location of the hernia is indefinite we may accept the patient's idea of the location as a key to the situation and make our incision accordingly; though some operators prefer to make a median laparotomy incision and search out the hernia from within, especially when the hernia is concealed by a pendulous or obese abdomen, or thick muscle walls.

In the accompanying table are recorded seventeen cases of lateral ventral hernia (including that reported herewith), eleven of which are not included among those tabulated by Augé and Simon in their recent paper. (*N. B.*—Cases Nos. 1, 2, 7, 9, 10, 11, 12, 14, 15, 16, 17.)

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THE LOW TRANSVERSE INCISION IN OPERATIONS UPON THE THYROID GLAND*

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THE failure of so many of the earlier lobectomies to cure a sufficiently large percentage of the toxic goitre cases led many years ago to the more complete removal of portions of both major lobes even to the extent of five-sixths or nine-tenths of the glandular tissue, as Porter states in 1916. More has been resected in these hyperplastic gland cases with excellent late result.

The liberal curved transverse incision enables us to expose the whole gland before commencing removal and to judge with considerable accuracy the amount of gland tissue to be left *and its character*. One still sees many lobectomies done for hyperthyroidism as well as for other conditions of the gland with the vertical straight, curved or angular incision and with the usual result of a more or less prominent and disfiguring cicatrix and considerable asymmetry of the neck. While most operators are agreed that Kocher's incision is the best for thyroidectomy, that is the curved transverse or collar incision across the neck over the most prominent part of the tumor mass, a fewer number are willing to concede that it is the best for nearly all operations upon the gland. It has its advocates for ligation of vessels alone. In conditions of hyperthyroidism this transverse incision with the ligation of enlarged subcutaneous and capsular veins of itself seems to have a greater therapeutic action than the smaller one-sided incision as Ochsner mentions in speaking of ligations and thyroidectomy. Its employment in highly toxic cases for simple ligation is scarcely advisable. It has been suggested that the beneficial action of simple ligation in this class of case is as much due to the interruption of the sympathetic nerve branches accompanying the large vessels as to the diminution of the blood supply. This is probably true.

Some years ago the observations of a somewhat prolonged stay at Kocher's clinic in Bern, impressed me very much with the advantages and possibilities of this wide cross incision. I would like to suggest a modification of this incision only to the extent that it be made even lower down, crossing the neck shortly above the sternal notch, and this for cosmetic reasons largely, although the practical absence of a lower flap allows better and shorter drainage and gives better access to the lower poles of the gland and to the retrosternal glandular tissue which is not an infrequent occurrence.

This incision for operations upon the gland begins at the external jugular vein upon one side and extends in a slightly downward curve across

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FIG. 1.—Adenoma of thyroid. Both lateral lobes affected. Four years and eight months after operation. Cricoid just seen.

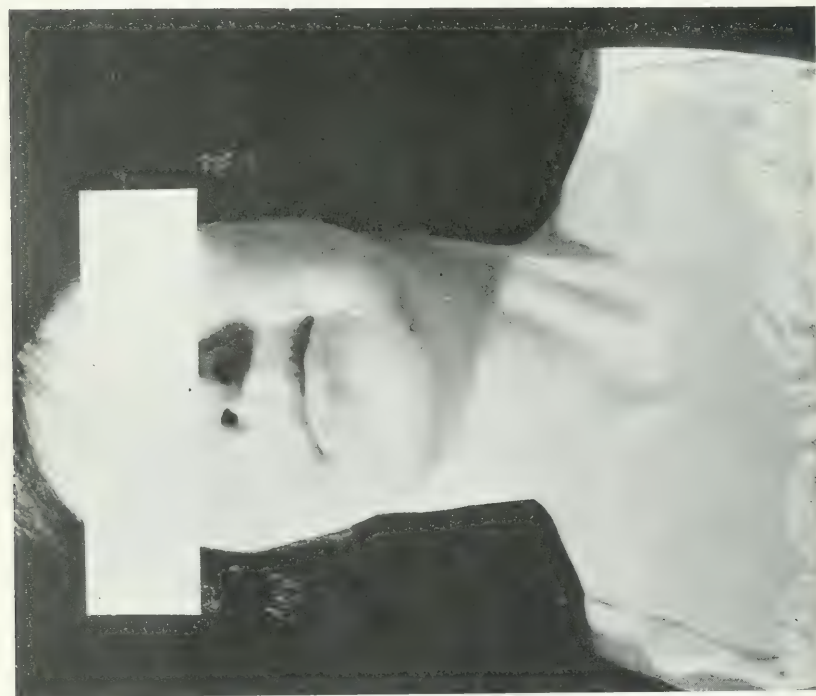


FIG. 2. Adenomatoid hyperplasia, affecting scattered areas both lobes. Ciacrix largely appreciable. Two years and seven months.



FIG. 3.—Large thyroid cyst with interstitial thyroiditis. Three years and eight months after operation.



FIG. 4.—Colloid goiter. Enlargement first noticed twenty years before operation. Four years and five months after removal.



FIG. 5.—Goiter chiefly colloid with adenomatous hyperplasia Toxic symptoms with elevation of metabolism rate. One year after removal.



FIG. 6. Cyst of thyroid isthmus. Line of incision just above sternal notch. Four years and five months after removal.



FIG. 7. Adenoma of thyroid. Moderate toxic symptoms. Symmetrical enlargement of gland beginning four years before admission. Ligation of arteries four months before thyroidectomy. Eight months after operation showing recent cicatrix.

the neck following as accurately as possible the lines of the neck and ends at the external jugular vein upon the other side. It has very rarely been necessary to prolong the line beyond these limits. The flap is reflected upward and the muscles retracted without cutting. The gland capsule and gland are well exposed. It has rarely been necessary with this exposure to cut the muscles. If we are dealing with an adenoma or cyst of one lateral lobe the incision need not be carried so far upon the other side. But it should always be sufficient to secure good inspection and ease of access. The length of the incision matters but little in the after-appearance and means much in the time saved at operation.

Such an exposure enables the operator to inspect the gland fully, remove tumors and gland tissue or the larger part of both lobes with the isthmus in hyperthyroidism with comparative ease. The elevation of the gland always leaving the posterior capsule intact and untouched, thus obviating danger to the recurrent nerves and the parathyroid tissue. It enables the operator to secure large vessels and main tributaries before beginning the removal and clamp every bit of tissue before its excision. This is a great advantage in the very vascular hyperplasias.

The rapidity with which such a flap can be raised and exposure secured has much to recommend it. There is but one precaution I would mention and that from a cosmetic standpoint. Where the skin of the neck and upper chest is quite mobile and the breasts rather heavy, the incision should cross a little higher or the final cicatrix may be drawn below the top of the sternum. There is often slight temporary œdema of the flap where good-sized veins are ligated, but this clears up rapidly.

This incision offers, therefore, a (1) more rapid and greater accessibility to the gland, (2) better inspection, (3) a safer and easier technic, and (4) the best cosmetic result.

Eighty-eight (88) per cent. of the cases have been seen following operation at periods varying from one to eight years after. The results have been so universally good that it has seemed worth recording this modification of an old incision. The photographs show average cases and are of patients accessible within the last month.

EXTRACRANIAL ANEURISM OF THE INTERNAL CAROTID *

REPORT OF A CASE

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ANEURISM of the cervical portion of the internal carotid artery is uncommon. Crisp,¹ in 551 aneurisms, found twenty-five of the carotids, and of these only three were of the internal. Wyeth,² in 789 ligations of the common carotid, mentions but four for aneurism of the internal carotid in its extracranial portion. Monod and Vanverts,³ in a collection beginning with 1895, tabulate eight cases. Bobbio,⁴ in 1906, cites eighteen. Many of the standard authors have never had a case under their personal supervision. Von Bergmann⁵ states there are but few observations reported on extracranial aneurism of the internal carotid and mentions only one instance that of Wyeth. In speaking of arterio-venous aneurism in the same locality, the above-mentioned author says, it is also a rare lesion and he incorporates in the text but two illustrative cases, one by Giralès,⁶ the other by Joret.⁷ Callander,⁸ in a recent contribution, adds ten additional examples. Two of these (Chartier⁹ and Quenu's¹⁰ cases) are fistulas between the common carotid and the internal jugular vein. Of the carotids the common is most frequently the seat of aneurism. According to Barwell,¹¹ eighty-seven and twenty-five hundredths per cent. affect the common; seven per cent. the external and five and seventy-five hundredths per cent. the internal carotid. The sole interest in this affection does not reside in its rarity, of equal concern is the liability of its being mistaken for tonsillar abscess, from its proclivity when it does occur, of appearing in the neighborhood of the tonsil. As a consequence of this peculiarity it has been lanced in the belief of its being a collection of pus. Lee¹² made this mistake, the patient bleeding to death in a few minutes.

Duke (*Dublin Med. Press*, 1848, vol. xix, p. 65) cites a similar accident. He was about to evacuate a supposed abscess in a patient of his when a finger fortunately introduced into the mouth detected aneurismal pulsation. A consultant did not consider the condition so serious and lanced the swelling. There was a gush of blood, the arrest of which necessitated ligation of the common carotid artery. The bleeding was controlled but the patient eventually died of secondary hemorrhage. Gross¹³ endeavors to drive this lesson home by graphically relating a case recorded by Syme.¹⁴ A woman had a tumor for about five months in the throat in the usual situation of abscess of the tonsil. It exhibited a diffuse appearance when viewed through the mouth and pulsated in a strong and characteristic manner throughout. Ligation of the common carotid diminished but did not entirely arrest the throbbing. The patient died thirty hours after the operation, without an assigned cause. Gross naively adds, had a less careful surgeon had the management of this case, he might probably have punctured the tumor under the

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supposition of its being an abscess, and thus hurled the patient out of existence. Agnew¹⁸ bases his opinion about making a diagnosis on the ability of the physician to both see and feel pulsation. Johnson¹⁹ and Booth¹⁷ have both reported cases in which they were unable to detect any pulsation or to hear a bruit. Agnew fails to take into consideration the possibility of the patient being unable to open the mouth sufficiently wide to permit the passage of a finger. Yet instances of this character have been recorded. The cases of Perier,¹⁸ Pircher¹⁹ and Neuffer,²⁰ quoted by Prewitt,²¹ serve to illustrate this point well.

Pircher (*Wien. med. Wochschr.*, 1862, p. 553) relates the history of a case in which the symptoms were so obscure and misleading that he completely failed to realize the true nature of the condition, believing until the death of the patient he was confronted with an acute abscess. The patient, a girl, aged eight years, was seized suddenly, January 12, 1862, with a severe pain and swelling in the upper part of the left side of the neck. The inflammatory process rendered opening of the mouth insufficient for the insertion of a finger. He was so convinced he was dealing with a deep-seated abscess that he lanced the neck, but not finding pus, as he thought at a sufficient depth, he desisted in the belief the abscess would work its way to the surface. About the eighth day there was a hemorrhage from the throat, after which the patient became more comfortable and could open the mouth. Pircher now inserted a finger, but could detect no pulsation, only a soft, fluctuating tumor occupying the left tonsillar region. He then called in two consultants who confirmed his opinion of abscess. Pircher, therefore, made a stab externally with a trocar, thus hoping to reach the abscess cavity, again without success. The child, however, continued to improve and was apparently on the road to recovery when early in the morning of February 7, 1862, after a restful night, she had a copious hemorrhage into the throat and expired in a short time. The author at no time seemed to sense the trouble and was unable to account for the origin of the bleeding. It was only at autopsy he became aware of the nature of the lesion.

In Perier's¹⁸ case there was rapid swelling in the throat, great pain, high fever, inability to open the mouth and altogether a condition so perplexing that Perier was unable to decide the true character of the disease. It was treated by rapid venesection and hot fomentations. At the end of nine days hemorrhage from the throat occurred and at intervals was repeated. On the fourteenth day M. Récamier was called in, and while attempting to introduce a finger into the mouth, which was done with great difficulty, a profuse hemorrhage occurred and the patient soon succumbed.

Neuffer's²⁰ case was that of a boy, thirteen years of age, who was taken with symptoms of inflammation of the throat and a diagnosis of angina tonsillaris was made, and the case treated as such. There were present fever, pain, swelling in the throat, noise and throbbing in the head and inability to open the mouth beyond three or four lines. On the twelfth day a profuse hemorrhage occurred. It was repeated on the next day and the patient soon expired. The autopsy showed an aneurismal dilatation of the internal carotid artery as large as a walnut with an opening leading into the pharynx.

The diagnosis of lesions in this region is mainly between aneurism of the extracranial portion of the internal carotid artery and abscess, rarely malignancy, and is to be determined upon the same general principles that apply elsewhere in differentiating these affections. The danger of falling into error in considering deep-seated tumors in the neck should ever be borne in mind. The history is of inestimable value in avoiding pitfalls. Mudd, in

Hulbert's²² case, obtained a history of a lump antedating a scarlatinal sore throat and was thus led to a correct conclusion. Failure to resort to digital examination when possible is inexcusable. Rely upon touch as your sheet-anchor and mistakes will be reduced to a minimum. The examples, above mentioned, should serve to illustrate the importance of making a careful examination in every instance of a smooth tumor lying behind the pharynx, or in which the tonsil is lifted out of its bed. The symptoms of aneurism of the internal carotid in this locality are, in the main, most characteristic and not as some observers would lead us to believe obscure. There will be a tumor pushing the tonsil inwards toward the midline or even across the middle of the pharyngeal cavity. With but rare exception, as hereinbefore noted, the lump is both accessible to sight and touch. It presents as either a circumscribed or somewhat diffuse, rounded, pulsatile swelling crowding into the fauces. To digital examination it is soft, elastic, and pulsates throughout its entire extent. Externally there may be no evidence of the disease, or there may be a fullness or a distinct tumor behind the angle of the jaw and in front of and below the ear. In the latter event pulsation is felt and a souffle is heard by auscultation over this area. With a finger inside the mouth and another on the neck, the mass is felt to be expansile. Both murmur and pulsation disappear when the common carotid artery is compressed against the vertebral column, to reappear immediately on release of the pressure. Arrest of the circulation causes a diminution in the size of the growth. Those afflicted with this affection often complain of an annoying roaring and buzzing in the ear, persistent, severe and unbearable hemicrania, vertigo, weakness and other symptoms due to cerebral circulatory disturbance. Swallowing of solids is sometimes impossible, and is usually accomplished with difficulty. Liquid food is frequently regurgitated. Dyspnoea is a common complaint. If the hypoglossal, glossopharyngeal or vagus nerve is involved, the organ which it serves is paralyzed, as indicated by deviation of the tongue on protrusion, interference with swallowing or hoarseness. As uncommon as is the disease, it occurs sufficiently often to call for a careful examination in every instance of unilateral pharyngeal tumefaction. When in doubt, the diagnosis may be made with the aspirating needle. A dry tap does not eliminate aneurism, as the point of the needle may be entangled in or its bore may be plugged with clot, but the withdrawal of pure blood is positive proof of its presence. As diagnostic puncture leaves the sac wall weakened, it should not be practised unless the patient is so situated that a prompt operation can be done in the event of a rupture through the path of the needle. It is true, aneurism of the internal carotid rarely points in the neck, but Prewitt,²³ Agnew,²⁴ and Pircher²⁵ are among those who have recorded observations of this sort. The absence of cervical swelling is explained by the dense cervical fascia in front and the cervical vertebrae behind crowding the gradually dilating sac inwards toward the tonsillar fossa where the comparatively weak superior constrictor muscle and the pharyngeal fascia interpose but slight resistance to its progress. Equally as fallacious is the contention of those who assert,

aneurism of the internal carotid always presents in the throat, as thoroughly reliable operative and necropsy proofs have been adduced to the contrary. Porter (*Dublin Hospital Reports*, 1830, v, 208, and later *Dublin Jl. Med. Sc.*, 1840, xvii, 83) reports a case of aneurism of the internal carotid without signs of tumor in the pharynx. The patient, a woman, came to autopsy seven years after the common carotid artery had been ligated for an aneurismal tumor in the upper part of the neck. The necropsy revealed the remnant of an aneurismal sac of the internal carotid artery. Moser (*Inaugural-Dissertation*, Strasburg, 1911, p. 7) tells of a woman who sought relief for a tumor in the right side of the neck which pulsated synchronously with the heart. Though nothing abnormal was found in the throat, at operation an aneurism was found springing from the internal carotid. In isolated instances pulsation may be absent or so weak as to escape detection. Under such circumstances the aspirating syringe has given the clew to the true nature of the lesion. In a chronic unilateral swelling with bizarre signs, unusual care needs be exercised to avoid a mistake in diagnosis. Dubrueil (*Gaz. méd. de Par.*, 1883, liv, 6.s., pp. 373 and 398) interpreted a case of this sort as an adenoma or sarcoma and attempted extirpation. During the process of enucleation he tore the sac wall and caused such a hemorrhage that a prompt ligation of the common carotid was necessary for its control. Several hours later the same day, he made a second ligation of the primitive carotid and at the same time tied the external and internal carotids and superior thyroid arteries for a repetition of the bleeding. Unfortunately the patient died on the fourteenth day of hæmiplegia. At autopsy an aneurism of the internal carotid was revealed as the source of the swelling. Helferich (*Deutsch. Ztschft. f. Chir.*, 1902, lxvii, 592) made the same mistake, but saved his patient by operation.

The surgical treatment of aneurism of this vessel in its extracranial course has necessitated attack at one time or another upon all of the carotids, therefore a brief consideration of the development of carotid surgery is not amiss. Hebenstreit²⁶ and Fleming,²⁷ in 1803, ligated the common carotid artery successfully for hemorrhage. In 1805 Sir Astley Cooper²⁸ ligated the common carotid for aneurism, the patient succumbing on the twentieth day. He repeated the operation in 1808, the aneurism was cured and the patient recovered. Since these ligations the common trunk has been tied times innumerable by many operators, for lesions of itself and branches. Syme²⁹ occluded it in 1842 for extracranial aneurism of the internal carotid artery. Gurdon Buck,³⁰ in 1848, tied the internal carotid for a wound. He had previously ligated the common trunk without success. W. T. Briggs,³¹ of Nashville, Tenn., in 1871, for traumatic aneurism of the internal carotid, ligated the internal branch above and below the sac successfully. Bushe,³² in 1827, ligated the external carotid for hemorrhage and Richard,³³ of Paris, in 1855 for aneurism. It remained, however, for John A. Wyeth³⁴ to place the surgery of the carotids upon a rational basis. In 1878 this surgeon attacked the prevailing practise of ligating the common carotid for lesions of

its branches. As a result of his investigations covering the reports of 789 ligations of the primitive carotid, eighteen of the internal and ninety-one of the external, he severely condemned the practice of tying the common for lesions of the external or its branches when a ligature can be applied between the diseased area and the bifurcation of the common carotid. He gave as his reason for this conclusion a death rate of four and one-half per cent. in ligation of the external against forty-one per cent. in the common. In lesions of the cervical portion of the internal carotid, aneurism excepted, he urged ligation of this vessel above and below the seat of trouble, because of the possibility of a recurrent flow through the circle of Willis with bleeding to death if the cardiac side alone is ligatured. In aneurism of the extracranial portion of the internal carotid artery the operation of choice is deligation of this vessel between the sac and common trunk, this despite the possibility of seepage from the circle of Willis, as the current in this event is too sluggish to cause trouble. Should this be infeasible, the common and external carotids should be tied, together with all branches of the external on the cardiac side of the ligature. If the common carotid alone be tied, there remains an open channel between the terminal branches through the segment of the primitive above its point of ligation by means of which the circulatory flow might be reestablished and the object of the operation compromised. According to Bobbio ³⁵ the common carotid has been ligated eleven times in eighteen cases of aneurism in the cervical portion of the internal carotid, with six recoveries. In relapsing aneurisms, which return despite ligation of the internal carotid, Matas ³⁶ suggests extirpation, or preferably, obliterative endo-aneurismorrhaphy, provided it is possible to secure the upper as well as the lower pole of the sac for hæmostatic purposes.

From the inception of carotid surgery until the present time, the possible occurrence of cerebral disturbances has invested a simple technical procedure with a gravity associated with but few operations. To avoid the evil results of disturbed cerebral circulation Halsted advises temporary occlusion of the common carotid under local anæsthesia before attempting obliteration of the diseased artery. Usually a defective circulation is indicated by the prompt appearance of dangerous symptoms. If untoward manifestations do develop the constricting band should be promptly removed. Although this precaution was not observed in my case, neither at the time of ligation nor subsequently, did any harmful symptoms arise? Perhaps the lack of development of baneful symptoms in ligation for aneurism is due to an already partially established collateral circulation. However, despite my experience competent operators are agreed ligation, either of the common or internal carotid, is not an operation to be undertaken lightly, because in a certain percentage of cases hæmiplegia follows the ligation and in many of these cases this complication is fatal. The paralysis is due to a thrombosis starting from the point of ligation and extending to the cerebral arteries. Johnson ³⁷ says it occurs in fifteen per cent. of the cases. According to DaCosta ³⁸ in from twenty to twenty-five per cent. of cases after ligature

of the common carotid artery there is cerebral softening or some other intracranial mischief. Crile³⁹ states of the cases developing cerebral trouble, one-half die. The direct operative mortality according to Crile is only three per cent. Horsley⁴⁰ states the danger of ligation of the common carotid increases enormously after forty years of age and is due to the diminished blood supply to the brain. In the young with elastic arteries, ligation of the internal or common carotid is comparatively free from danger. In the opinion of this surgeon cerebral symptoms vary from giddiness to complete hæmiplegia. As a security against undesirable symptoms, Jordan,⁴¹ of Heidelberg, recommends a procedure which proved itself of value in animal experiments as well as in an operation for carcinoma of the neck, *viz.*, previous loose constriction of the carotid for forty-eight hours. By carefully constricting the carotid by means of a small flat piece of tape or catgut until the peripheral pulse just ceases, there is no injury to the intima and no clot formation. If the ligature be removed after two days, the peripheral pulse reappears and soon attains its normal strength. Preliminary ligation should be done under local anæsthesia so as to obtain prompt information of the cerebral effects. If disturbances occur after the constriction, the ligature is immediately removed from the artery through the wound, which has been left open, and the circulation restored to normal. By gradually increasing the constriction of the ligature one can under certain circumstances cause the development of a collateral circulation which may at first have been insufficient. This is also the teaching of Halsted and is based on the toleration of the carotid for temporary occlusion. Crile has demonstrated the common carotid may be clamped for forty-eight hours without permanently damaging the artery or causing thrombosis. Halsted employs the aluminum band for this purpose. It must not be forgotten that cerebral symptoms and death may occur one or two weeks after ligation. Matas³⁸ says in the light of this important suggestion the entire surgical treatment of the carotid must be revised. In the future no one will be justified in planning a deliberate operation for the cure of aneurism in this perilous locality without first testing the efficiency of the collateral circulation.

Aneurism in this situation is either true or false. The true are those in which either one or all of the tunics enter into the composition of the sac; the false are those in which the sac wall is formed by adventitious tissues. According to their causation, they may be classified as (1) spontaneous, (2) erosive, (3) traumatic. The spontaneous are those without apparent cause, hence the synonyms idiopathic, arterio-sclerotic, endogenous. The erosive are formed in abscess cavities by the absorption of the arterial walls by pathogenic microorganisms or their products, especially the pyogenic, hence exogenous, false. The traumatic are those due to contusions, bullet and stab wounds, etc. These may involve the artery alone or the artery and its accompanying vein. Recently much confusion has crept into the nomenclature by the misapplication of the term aneurism to recent collections of extravasated blood which pulsate. Such cases have been omitted from this

article, as these pulsating hæmatomata have no well-defined wall of fibrous tissue lined by endothelium. No matter what the type, they all give rise to practically the same symptoms and tend to present in the lateral wall of the pharynx.

The purpose of this paper is to insure a prompt recognition of this obscure lesion when it does occur, to assemble all facts pertinent thereto, to render in abstract, for the convenience of those interested in a further study of the condition, the cases reported in the literature and in particular to place on record a case that came under my care.

CASE.—J. T., a colored woman, married, aged forty-eight, cook, was admitted to the University Hospital, Baltimore, January 24, 1921, and discharged February 9, 1921, for a tumor in the throat, of nine months' duration. There was nothing in either her family or personal history which had any bearing on her condition. In April, 1920, she noticed a right-sided tonsillar swelling for which she called in a local physician, who, mistaking it for a tonsillar abscess, made a stab, evacuating only blood, no pus. Much to the woman's chagrin, instead of the lump decreasing in size, it gradually grew larger and finally so encroached on her fauces as to interfere with swallowing and to materially embarrass breathing. In addition there developed a most annoying roaring in her right ear, and with each cardiac impulse she felt as though her head would be jarred off her neck. She complained bitterly of a rhythmical thumping in the neck situated immediately behind the angle of the right jaw, persistent and intense headache and muffling of the speech. Upon viewing the throat through the mouth, a mass could be seen projecting inwards from the right pharyngeal wall and impinging on the uvula. The tumor was diffuse, smooth, elastic to touch and pulsated in its entire extent. It was located behind a rather small but otherwise normal tonsil. There was no discharge or ulceration. A puncture scar on the anterior pillar was plainly visible. Upon compression of the common carotid pulsation was promptly arrested to instantly return with the release of pressure. There was a puffiness behind the angle of the jaw, but no distinct tumor could be detected. With a stethoscope placed over this area a bruit was plainly heard. Combined intra- and extra-buccal pressure diminished the size of the swelling. With the above exception, examination of the body was non-productive. The blood-pressure was 130/80, the blood Wassermann negative, urine negative, the white cell count 11,400, polymorphonuclears fifty-nine per cent., small mononuclears thirty-one per cent., large mononuclears five per cent., large lymphocytes two per cent., eosinophiles two per cent., basophiles two per cent. The non-protein nitrogen, uric acid, creatinin, urea nitrogen and sugar content of the blood were all within normal range. X-ray examination of the cervical spine was negative. From the clinical findings a preoperative diagnosis of aneurism of the internal carotid artery in its cervical course was made. As the condition was urgent, operation was advised and accepted.

Operation: February 1, 1921; operator, Nathan Winslow, assistant, W. D. Owens; anæsthetist, C. R. Goldsborough. Under ether anæsthesia, the common carotid and its terminal branches were exposed and uncovered of their sheath from a little above to an inch below the bifurcation. Pinching the external carotid had no effect upon the pulsation of the tumor, but squeezing the common trunk arrested the throbbing instantly. A twisted-silk ligature was then applied to the external carotid close to its origin and another to the common carotid just below its division in order to cut off all possible channels to the internal carotid. With the tying of the ligatures all movement of the tumor ceased in-

stantly, never to reappear. The shutting off of the circulation had no effect on either pulse or respiration. The wound was closed without drainage. The patient was returned to bed in excellent condition. Convalescence was uneventful except for a transitory headache which disappeared in a few days. There was no rise in temperature worthy of note, no evidence of cerebral disturbance, no dizziness, no vertigo, no paralysis. Ten months have elapsed since the operation, the mass in the mouth has entirely disappeared, the roaring in her ear has ceased, there is no more jarring of her head, the hemicrania has stopped, no bruit is audible, no pulsation can be obtained. Though the trouble could have followed an erosion of the arterial wall by a deep-seated inflammatory process, there is not sufficient evidence to think the woman ever had a tonsillitis. An equally as plausible explanation is that the doctor nicked the vessel wall in doing puncture, but this does not explain away the preëxisting lump. From the one-sided origin of the trouble, my belief is that this aneurism occurred spontaneously, without appreciable cause, as witnessed by her previous excellent health. The negative Wassermann would seem to preclude lues.

Besides the nineteen cases cited in Tables I and II, I have found fifty-one cases recorded in the foreign literatures (see list appended). It is unlikely these represent all of the published cases. The list is as exhaustive, however, as a careful search of the literature would permit. In all but a few the original article was consulted, when this was inaccessible a reliable transcript was made use of. They number seventy. Of these thirty-six are spontaneous, ten erosive, thirteen traumatic and ten arterio-venous. In addition to these was one which cannot be classified. It was found by Arnould (*Bull. et mém. de la Soc. Anat. de Par.*, 1914, lxxxix, 168) in a subject in the dissecting room. Thirty-seven were males, thirty-one females, two not stated. In the spontaneous variety the females outnumbered the males by twenty-six to nine; in the remaining example of this type the sex was not given. Of the forty-eight instances in which cure was attempted by operation, thirty-two recovered, sixteen died. Of these, thirty were operated on since 1890, with twenty-four recoveries and six deaths; eighteen previous to 1890 with eight cures and ten fatalities. Twenty-one were not operated on. Of these, sixteen perished, one made a spontaneous cure (Lyt and Petit⁴²), and four were in the same or worse condition when the report was made. The clinical course of the case found in the dissecting room was not known. Puncture was done for abscess five times. Of these cases one died immediately of uncontrollable hemorrhage, one three days later from a renewal of the bleeding. In the other three the common carotid was ligated immediately with the following result—one recovery and two deaths. Wagner⁴³ was spared this humiliation by failing to take along with him his instruments. Upon his return the next morning he was informed the patient had died during his absence of a hemorrhage into the mouth. The diagnosis was made five times by the aspiration of pure blood. In two instances the condition was taken for sarcoma and during attempt at extirpation the sac wall was torn. In both cases ligation of the main carotid and its internal branch arrested the hemorrhage,

one patient recovered but the other died, fourteen days afterwards, of hæmi-plegia; two patients died on the operating table, one of asphyxia from rupture of the sac into the fauces and inhalation of the escaping blood, the other from the effects of chloroform. Treatment by compression was tried three times; twice it was supplanted by ligation, in the other case Vander Veer⁴⁴ thought he had made a cure, but about three months later the man suddenly fell dead. McMullen and Stanton⁴⁵ in their case attempted to make a cure by a restorative aneurismorrhaphy. The patient apparently convalesced nicely and had been discharged from the hospital, but a few days afterwards had to return for a hæmatoma beneath the scar. The wound was reopened and the source of the bleeding discovered to be from a rent in the wall of the vessel. Attempts to clamp the vessel failed on account of the friability of the tissues and the hemorrhage was only controlled with considerable difficulty by tamponing the wound. The patient had lost so much blood that she died three hours afterwards of collapse. LeFort,⁴⁶ in a case of arterio-venous aneurism, incised the vein, sutured the hole in the artery and capped the suture line with a section of the vein. Bruns,⁴⁷ Perthes,⁴⁸ Morestin⁴⁹ and Moser⁵⁰ practised extirpation of the sac. Agnew,⁵¹ because of recurrence of pulsation in the sac, ligated the opposite carotid, but the patient died about a week later of secondary rupture of the sac into the mouth and sepsis. The common carotid was ligated alone twenty-two times with satisfactory results in thirteen instances. The internal carotid was ligated alone four times, with three recoveries and one death.

The ages were 8, 19, 19, 24, 23, 26, 28, 28, 30, 32, 35, 36, 38, 38, 40, 40, 41, 42, 44, 47, 48, 50, 58, 58, 60, 60, 63, 65, 74, 75, 76, 60, 60, 4, 6, 8, 9, 13, 18, 19, 20, 58, 60, 21, 22, 23, 25, 27, 28, 35, 48, 17, 20, 23, 25, 25, 28, 29, 32, 35, 37 years, respectively, a total of 61; the remaining nine are described as women twice, soldiers thrice, child once, men twice, dissecting room subject once. Those with the ages recorded were divided into decades as follows:

	1-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	Total
Spontaneous	1	2	5	6	7	3	6	3	33
Erosive	4	3	1	0	0	1	1	0	10
Traumatic	0	1	6	3	0	0	0	0	10
Arterio-venous	0	0	6	1	1	0	0	0	8
Total	5	6	18	10	8	4	7	3	61

Of the twenty-eight representatives of the erosive, traumatic and arterio-venous groups, twenty-one occurred before thirty years of age, whilst in the spontaneous series, twenty-five were first noticed after the third decade. The youngest patient was four years of age, the eldest seventy-six. Of the five between four and ten years of age, one recovered after ligation of the common carotid (Wulff, *Munch. med. Wochshft.*, 1900, p. 687), one died under anæsthetic (Hirsch, *Monatshft. f. Ohrenhlkh.*, Berlin and Wien, 1914, xlviii,

780), one died of secondary hemorrhage from the sac into the mouth after ligation of the common carotid (Liston, *Lancet*, London, 1842, i, 864) and two died without operation. Five out of the six patients between ten and twenty died, two without operation, one of rupture of the sac into the mouth during an attempt to ligate the internal carotid, and two of sepsis after ligation of the common carotid; the one to recover is reported to have made a spontaneous cure. Of the three patients in their seventies, one died after ligation of the common carotid of cerebral complications, one died without operation and one was in the same condition when discharged. Of those in their sixties, five recovered after operation, one died of hemorrhage secondary to aneurismorrhaphy and one after ligation of the common carotid with no assignable cause. These figures would seem to indicate that those below twenty and above seventy withstand this condition poorly. Of the thirty-six spontaneous, twenty-four were operated on, with fifteen recoveries and nine deaths; of the twelve unoperated, nine died and three were in the same condition or worse; of the ten erosive, seven were operated on with three recoveries and four deaths, three were unoperated, with two deaths and one recovery; of the thirteen traumatic, six recovered after operation, four succumbed, three were not operated on, all died; of the ten arterio-venous, eight were operated on, all recovered; two not, both died. Six of the sixteen operative deaths were attributed to cerebral complications, or thirty-seven per cent. Therefore in this series twelve and five-tenths per cent. of the patients operated upon died of cerebral disturbances. Seven of the operative deaths were attributed to secondary hemorrhage, two to sepsis and one to no assignable cause.

Though strictly speaking, not entirely confined to the internal carotid, a case of aneurism involving all three carotids reported by Walsham (*Proc. Roy. Med. and Surg. Trans., Lond.*, 1899, lxxxii, 223) merits notice here. The patient was a man, forty-nine years old, with the complaint of a swelling in the right side of the neck of six years' duration. The growth was the size of a cricket ball, globular, hard, and extended from the jaw almost to the clavicle. It did not pulsate and was not diagnosed until operation. It was suspected as a malignant tumor. A trocar was inserted but failed to evacuate blood. There was no bulging in the throat, no dyspnoea, no dysphagia. The operation done in 1895 consisted of ligation of the common carotid, external and internal carotids and extirpation of the sac. The patient was cured. Prosser (*Br. Med. Jl.*, 1897, i, 530) and Langenbuch (*Reunion libre des chir. de Berl.*, Séance du 14 Dec., 1891, in *Mecredi méd.*, 1892, 111, No. 2, 21) report cases which have been cited as aneurism of the internal carotid artery. Owing to the indefiniteness of the reports, I have not included them in my collection. The following cases have been excluded because of insufficient evidence being adduced by the authors to substantiate their claims: Ludwig Meyer (*Archiv f. Psychiatrie*, Berl., 1875, vi, 84), in an article entitled "Ueber aneurysmatische Veraenderungen der Carotis interna Geisteskranker," includes what he considers eight examples of aneurism of the extracranial portion of the internal carotid artery. All of the observations were made at autopsy upon mentally deranged patients. From the solitary illustration featuring the article and the subject matter of the text, I am not inclined to admit them as aneurisms. The condition rather appears to have been a slight thickening of the arterial wall

at its point of origin. C. E. Benjamins (*Archiv f. Ohrenheilkunde*, 1908, lxxvi, 240) reports a case of aneurism of the right internal carotid with fatal bleeding from the right external auditory meatus from necrosis of the floor of the canal following the insufflation of arsenic powder by a medicine man for the cure of a discharge. The patient, a woman, fell into Benjamins' hands shortly thereafter, but died. Autopsy developed an aneurism of the internal carotid but I could not determine whether it was in the extracranial portion of the internal carotid or in the bony canal, so have not included it in the tabulation. Certainly there were no pharyngeal symptoms. At the time of the hemorrhage Benjamins believed the source to be an erosion of the internal jugular vein because pressure upon the common carotid artery did not control the bleeding. Frisch (*Berl. klin. Wochenshft.*, 1916, liii, 99) presented before the Royal Society of Physicians of Vienna, at the December 10, 1915, meeting, a patient with what he believed an aneurism of the internal carotid located at the base of the skull. The trouble originated from a gunshot wound. The presence of such signs as hoarseness, atrophy of the sterno-cleido-mastoid muscle and the half of the tongue corresponding to the affected side, and the development of a contracted pupil and ptosis on the side of the injury indicated damage to the vagus, spinal-accessory, hypoglossal and cervical sympathetic nerves. Behind the angle of the jaw was a pulsating tumor. Calcium lactate taken internally and pressure to the mass caused the pulsation to become less pronounced. Shaefer (*Allgemeine Zeitsft. f. Psychiat. u. Pyschisch-Gerichtliche Medic.*, 1887, xxxiv, 438), in an article, "Ueber die aneurysmatische Erweiterung der Carotis interna an ihren Ursprung," describes the same condition as aneurism as Meyer. To my mind the cases reported by Shaefer are not true aneurism. Ehrmann, of Mulhouse (*Bull. et mêm. de la Soc. de Chir. de Par.*, 1878, n.s., iv, 664), reports the following very suggestive case: The patient, a male, aged twenty-two, laborer, of healthy appearance and good habits, entered the hospital April 28, 1875, in the service of Doctor Battenburg for an angina tonsillaire of but a few days' duration, which had localized on the right side. He complained of pain in the submaxillary region, dysphagia and fever. May 1st, toward 6 A.M., the abscess opened spontaneously into the throat, at the same time a stream of red blood flooded the mouth. When the sister on service reached the patient the hemorrhage had ceased. At 9.30 A.M. a new hemorrhage as sudden as the first, but less abundant, occurred. Inspection of the throat, which was accomplished with difficulty owing to the locking of the jaws, revealed redness, œdema and tumefaction of the velum and a distinct impulse was transmitted to a palpating finger. Scarcely a half hour later there was a repetition of the bleeding but on a grander scale. The patient was now in a state of syncope, quite exsanguinated, pulse thready and extremities cold. Delay was no longer permissible, so Ehrmann, with the assistance of Battenburg, made a ligation of the common carotid artery. On account of the size of the swelling the vessel had to be ligated below the omohyoid muscle. The post-operative course was favorable. There was no further bleeding, but by the end of the first week there was a tolerably severe febrile reaction with a persistence of the submaxillary puffiness. Finally there was a discharge into the mouth of a fetid pus. At no time were there any cerebral or nervous disturbances. In the beginning there was some aphonia, which, however, completely disappeared in three or four days. The patient was discharged cured, June 18, 1875. Ehrmann considered this a case of erosion of the internal carotid artery. A number of similar cases are recorded in the literature, notably by H. Fischer (*Arch. f. klin. Chir.*, 1899, lviii, 435), Pepper (*Br. Med. Jl.*, 1872, xi, 510), Hynes (*Lancet*, 1870, xxiv, 9), Fraser (*Br. Med. Jl.*, 1872, xi, 25), and Lovegrove (*Lancet*, 1870, xxi, 5).

CONCLUSIONS

1. Aneurism of the cervical portion of the internal carotid artery is not as infrequent as supposed.

2. Before incising a unilateral lump in the neighborhood of the tonsil, especially if of long standing, look, feel, listen.

3. Spontaneous cure may occur, but the usual termination in untreated cases is death from rupture into the fauces.

4. The operation of choice is occlusion of the internal carotid proximal to the sac. If this be impossible then ligation of the common carotid artery, together with a ligation of the external carotid, between its origin and first branch. If the external carotid be tied distal to a branch, that branch must likewise be occluded.

5. After ligation the prognosis is fair both as regards operative recovery and permanent cure.

6. Aneurism in other localities is by far more prevalent in the male than in the female; in the internal carotid it occurs in almost an equal ratio in the two sexes, being slightly more prevalent in the male if all types are considered, but much more frequent in the female in the spontaneous variety.

LIST OF CASES REPORTED IN LITERATURE

Spontaneous:

- 1 Cooper: Lectures of, 3rd Amer. Ed., 1831, ii, 62.
- 2 Dupuytren: Leçons orales de clin. chir., 1839, ii, 56.
- 3 Porter: Dublin Hosp. Rpts., 1830, v, 208, and Dublin Jl. Med. Sc., 1840, xvii, 83.
- 4 Porter: Dublin Jl. Med. Sc., 1840, xvii, 86.
- 5 Syme: Lond. and Edinb. Month. Jl. Med. Sc., 1842, ii, 961.
- 6 Perier: Rec. de mém. de méd. et de chir. et de phar. Milit., 1854, 2. s., xiv, 311.
- 7 Duke: Dublin Med. Press, 1848, xix, 65.
- 8 Chassaignac: Bull. de la Soc. de chir. de Par., 1859, x, 83.
- 9 Pircher: Wien. med. Wochshft., 1862, p. 553.
- 10 Godfray: Med. Times and Gaz., 1882, ii, 409.
- 11 Vander Veer: Trans. Amer. Surg. Assoc., 1886, iv, 253.
- 12 Agnew: Trans. Amer. Surg. Assoc., 1886, iv, 252.
- 13 Dubrueil: Gaz. méd. de Par., 1883, liv, 6. s., v, 373 and 398.
- 14 Wyeth: New York Med. Jl., 1883, xxxviii, 428.
- 15 Creus: El Genio medico-quirurgico, 1884, xxx, 191.
- 16 Coomes: The Med. Herald, 1885, vii, 503.
- 17 Hulbert: St. Louis Courier Med., 1886, xvi, 265.
- 18 Clementi: La Riforma Medica, 1890, vi, Part I, 478.
- 19 Richardson: Jl. Amer. Med. As., 1890, xv, 180.
- 20 Edmunds: Trans. Path. Soc. Lond., 1891, xliii, 42.
- 21 Polak: Weekbl. Nedrl. Tijd., 1895, xxxi, Part II, 992 and 1900, xxxvi, 1, 1213.
- 22 Narath: Nedrl. Tijdsft. v. Geneesk. Amst., 1903, 2. R., xxxix, 1174.
- 23 Mayo, C. H.: St. Paul Med. Jl., 1899, i, 751.
- 24 Minich: Pest. med. chir., 1901, xxxvii, 765.
- 25 Helferich in Werner: Deut. Ztshft. f. chir., 1902, lxvii, 595.
- 26 Van Campen: Nedrl. Tijdsft. v. Geneesk. Amst., 1903, 2. R., xxxix, 1172.
- 27 Texier: Bull. méd. Par., 1907, xxi, 593.
- 28 Texier: Bull. méd. Par., 1907, xxi, 593.
- 29 McMullen and Stanton: ANNALS OF SURGERY, 1910, li, 76.

30. Texier and Levesque: *Gaz. méd. de Nant.*, 1910, xxviii, 466.
31. Moser: *Inaug.-Dissert.* Strasburg, 1911, p. 7.
32. Perthes in Keppler: *Inaug.-Dissert.*, Leipzig, 1910.
33. Wagner in Keppler: *Inaug.-Dissert.*, Leip., 1910, p. 14.
34. Liébault et Clavaud: *Arch. gén. de chir. de Par.*, 1912, vi, 1436.
35. Shipley and Lynn: *Jl. A. M. A.*, 1916, lxvi, 1602.
36. Winslow: *ANNALS OF SURGERY*, 1922, lxxv, p. 688.

Erosive:

1. Liston: *Lancet*, Lond., 1842, i, 864.
2. Neuffer: *Ztschft. f. Wundaertze u. Geburtsh*, 1852, iv, 206.
3. Heaton: *Birmingham Med. Rev.*, 1891, xxx, 304.
4. Lyot and Petit: *Gaz. méd. de Par.*, 1897, 10. s., i, 159.
5. Wulff: *Muench. med. Wochsft.*, 1900, p. 687.
6. Johnson: *Trans. Amer. Laryng., Rhin. and Otol. Soc.*, 1901, vii, 226.
7. Zamboni in del Fabbro: 13 *Cong. intern. de méd. Par.*, 1900, sec. de chir. gén., x, 516.
8. Bruns in Blauel: *Beitr. z. klin. Chir.*, 1903, xxxix, 620.
9. Hirsch: *Monatshft. f. Ohr., Ber. and Wien*, 1914, xlviii, 780.
10. Klarfeld: *Wien. klin. Wochsft.*, 1915, xxviii, 1361.

Traumatic:

1. Mettauer: *Amer. Jl. Med. Sc.*, 1849, n.s., xviii, 351.
2. Fingerhuth: *Preussische med. Zeitung*, 1864, vii, 183.
3. Briggs: *Nashville Jl. Med. and Surg.*, 1871, n.s., vii, 102.
4. Lee in Fenger and Lee: *Gaillard Med. Jl.*, 1882, xxxv, 10.
5. Prewitt: *Trans. Amer. Surg. Assoc.*, 1886, iv, 233.
6. Duchamp: *La Loire méd.*, 1898, xvii, 113.
7. Booth: *Phila. Med. Jl.*, 1900, vi, 1002.
8. Ciechowski in Lewenstern: *Cent. f. chir.*, 1901, p. 1228.
9. Bobbio: *Policlin. Roma*, 1906, xiii, sez. chir., 50.
10. Morestin: *Bull. et mém. Soc. de clin. de Par.*, 1915, n.s., xli, 2443.
11. Bouchard: *Rév. gén. de clin. et de Thera. Par.*, 1916, xxx, 104.
12. Page in Makins: *Br. Jl. of Surg.*, 1915-1916, iii, 378 and 404.
13. Gjurgevitch in Soubbotitch: *Deut. Zeitschft. f. chir.*, 1914, cxxvii, 462.

Arterio-venous:

1. Joret: *Gaz. méd. de Par.*, 1840, 2. s., viii, 457.
2. Giraldès: *Bull. Soc. de chir. de Par.*, 1854, v, 70.
3. Keen: *Med. and Surg. Reporter*, Phila., 1894, lxx, 380.
4. Janssen: *Kiel*, 1903.
5. Cushing in Callander: *Johns Hop. Hosp. Repts.*, 1921, xix, 301.
6. Dufourmentel: *La Presse méd. Par.*, 1917, xxv, 50.
7. Le Fort: *Bull. de l'Acad. de méd. Par.*, 1917, 3. s., lxxviii, 108.
8. Lannois and Patel: *La Caducée*, 1915, xv, 127.
9. Bland Sutton: *Br. Jl. Surg.*, 1915, iii, 490.
10. Heuer in Callander: *Johns Hopk. Hosp. Rpts.*, 1921, xix, 302.

Unclassified:

1. Arnould: *Bull. et mém. de la Soc. Anat. de Par.*, 1914, lxxxix, 168; specimen found in dissecting room subject, clinical course not known.

Since submitting this article for publication, from sources previously unavailable I have collected the following additional cases of extracranial aneurism of the internal carotid artery:

Spontaneous:

37. Jianu: *Revist. de Chir.*, Bucuresti, 1909, xiii, 536; lig. C.C.A., cured.

Erosive:

11. Vas: *Jahr. f. Kindhlk.*, 1916, lxxxiii, 493; incised for abscess, died of hem.
12. Ransohoff: *ANNALS OF SURGERY*, 1918, lxxviii, 152; lig. C.C.A., cured.
13. Beck: *Monatshft. f. Ohrhlk. u. Laryngo-Rhin.*, 1918, lii, 606; no op., mortal hem. from nose and mouth, aneur. disc. only at autopsy.
14. Pusateri: *Il Policlin.*, Roma, 1918, sez. prat., xxv, 475; no op., fatal hem. six and one-half mos. after onset of lesion.

Traumatic:

14. Pribram: *Arch. f. klin. Chir.*, 1917, cviii, 680; lig. I.C.A., cured.
15. Pribram: *Arch. f. klin. Chir.*, 1917, cviii, 680; lig. C.C.A., died tenth day of cerebral softening.
16. Pribram: *Arch. f. klin. Chir.*, 1917, cviii, 680; lig. C.C.A., died third day of cerebral softening.
17. Rauchenbickler: *Arch. f. klin. Chir.*, 1918, cx, 700; suture of proximal segment I.C.A., double lig. I.J.V., died on table, autopsied.
18. v. Eiselberg in Ranzi: *Arch. f. klin. Chir.*, 1918, cx, 656; partial occlusion I.C.A., improved.
19. Orth: *Beitr. z. klin. Chir.*, 1917, cv, 347; no op., final result not stated.
20. Johnsen in Gabriel: *Beitr. z. klin. Chir.*, 1919, cxvi, 583 and 584; lig. E.C.A., died, softening of the brain, correct diag. establish. by autopsy.
21. Vegas: *Rev. espan. med. and chir.*, 1920, iii, 379; lig. C.C.A., I.J.V., cured.
22. Bier in Kuettner: *Beitr. z. klin. Chir.*, 1917, cviii, 6 and 43; found at autop on rt. side, also aneu. of lt. vertebral present for which lt. C.C.A. had been lig., sac incised and packed.
23. Reich: *Muench. med. Wochsft.*, 1915, lxii, 200; simultaneous aneurisms of int. and exter. carotids, no further details.
24. Kalima: *Jl. de Chir., Par.*, 1920, xvi, 74; lig. all carotids and sup. thyroid, excision of sac, cured.
25. Gilberti: *Il Policlin.*, 1918, sez. prat., xxv, 557; lig. I.C.A., C.C.A., I.J.V., cured.
26. Herzen: *Jl. de Chir.*, Paris, 1911, vii, 677, abst. from *Chioururgia*, 1911, xxx, No. 177, 95 (Sept. supplement).

Arterio-venous:

11. Haberer: *Arch. f. klin. Chir.*, 1916, cvii, 662; quadruple lig., cured.
12. Suchanek: *Arch. f. klin. Chir.*, 1918, cx, 682; lig. I.C.A., I.J.V., imp.
13. Bier: *Deut. med. Wochsft.*, 1915, xli, 122 and 123; vessel suture, cured, no description of op.
14. Ortenberg: *Muench. med. Wochsft.*, 1917, lxiv, 237; lig. I.C.A., C.C.A. and vertebral, cured.
15. Gilson Hermann in Lenormant: *Jl. de Chir., Par.*, 1921, xvii, 138; lig. all carotids and I.J.V., cured.
16. Gault in Lenormant: *Jl. de Chir.*, Paris, 1921, xvii, 138; lig. I.C.A., tamponing of lateral sinus through an opening made in the mastoid, next day lig. C.C.A., cured.

NOTE.—Added to those previously reported, this makes a total of ninety-four examples of aneurisms of the extracranial segment of the internal carotid artery.

TABLE I.—Cases operated on by American Surgeons.

No.	Surgeon	Reference	Sex	Age	Side	Duration	Operation	Date	Rec.	Died	Cause of death	Type	Cause	Remarks
1	Mettauer...	Am. Jl. Med. Sc., 1849, n.s., XVIII, 351	M	25	R	6 weeks	C. C. A.	3-8- 1842	....	Yes	12 days, cerebral complications	T	Puncture	
2	Briggs.....	Nashville Jl. M. & S., 1871, VII, 102	M	23	L	6 weeks	C. C. A.	2-23- 1871	Yes	....	.....	T	Stab	
4	Wyeth.....	N. Y. Med. J., 1883, XXXVIII, 428	F	60	L	10 years	I. C. A. E. C. A. S. T. A.	.....	Yes	....	.....	S	No	
5	Prewitt.....	Trans. Am. Surg. Assoc., 1886, IV, 235	F	17	R	3 mos	C. C. A.	4-4- 1885	....	Yes	5 days, sepsis	T	Pistol	
6	Hulbert.....	St. Louis Cour. Med., 1886, XVI, 265	F	19	R	.....	C. C. A.	.....	....	Yes	Hemorrhage and asphyxia	S	No	First lanced for abscess, no pus, diagnosis made by aspirating pure blood.
8	Agnew.....	Trans. Am. Surg. Assoc., 1886, IV, 252	F	...	...	8 mos	Both C. C. A. & S. T. A. L. A.	.....	....	Yes	Hemorrhage and sepsis	S	No	As the ligation of the C. C. A., S. T. A. and L. A. of the af- fected side did not control pul- sation, the opposite C. C. A. was lig. also, despite this sac burst, hem. checked by packing but pa- tient died later of sepsis.
11	Keen.....	Times and Reg., Phila., XXVII, 151	M	23	L	3 years	E. C. A. C. C. A.	.....	Yes	....	.....	AV	Pistol	
12	Mayo, C. H.,	St. Paul Med. J., 1899, I, 751	F	23	R	6 years	I. J. V. C. C. A.	8-2- 1889	Yes	....	.....	S	No	
15	McMullen & Stanton	Annals of Surg., 1910, LI, 76	F	60	R	1 year	Endoa- neurism- orrhaphy	12-29- 1908	....	Yes	Secondary hem. and exhaustion	S	No	In this case a restorative endo- aneurismorrhaphy was done apparently with success but the patient later died of secondary hem. These are the only Amer- ican operators to attempt this character operation for aneur- ism of the internal carotid.
16	Shipley.....	Jl. A. M. A., 1916 LXVI, 1602	F	41	L	.....	E. C. A. C. C. A.	1-31- 1915	Yes	....	.....	S	No	
17	Lynn & Cushing.....	Johns Hopkins Hosp. Rpts., 1921, XIX,	M	28	R	.....	I. C. A.	.....	Yes	....	.....	AV	Injury	
18	Heuer.....	Johns Hopkins Hosp. Reports, 1921, XIX, 302	M	48	R	.....	Band to I. C. A.	.....	Yes	....	.....	AV	Injury	
19	Winslow, N.,	Annals of Surg., Vol. LXXV, 688	F	48	R	9 mos	E. C. A. C. C. A.	2-1- 1921	Yes	....	.....	S	No	Physician in attendance lanced for abscess.

T. traumatic. AV. arteriovenous S. spontaneous.

TABLE II.—Cases observed by American Surgeons but unoperated.

No.	Author	Reference	Sex	Age	Side	Duration	Rec.	Died	Cause of death	Type	Cause	Remarks
3	Fenger & Lee	Gaillard Med. J., 1882, XXXV, 10	M	28	R	15 days	...	Yes	Hemorrhage, operative	T	Pistol	Mistook for abscess (Lee), lanced, died almost instantly.
7	Coomes.....	The Medical Herald, 1885, VII, 503	F	...	L	10 days	...	Yes	Spont. hemorrhage	S	No	She bled from the mouth 6 days before Coomes stuck a finger in the mouth, recognized pulsation and determined the diag. Autop.
9	Vander Veer....	Trans. Amer. Surg. Assoc., 1886, IV, 253	M	40	L	.....	....	Yes	?	S	No	On two separate occasions treated by compression, thought he had effected a cure, man returned home, died suddenly, autopsy failed to determine the cause.
10	Richardson.....	Jl. A. M. A., 1890, XV, 186	F	35	R	.....	?	?	.....	S	No	Fate not known, no treatment.
13	Booth.....	Phila. Med. J., 1900, VI, 1002	M	25	L	18 days	....	Yes	20 days, spont. hem. exhaust	T	Injury	Biopsy for diag., no other operation. Pathol. reported no evidence of malignancy.
14	Johnson.....	Trans. Amer. Laryng., Rhin. & Otol. Soc., 1901, VII, 226	M	4	L	10 days	...	Yes	6 months, spont.	E	Toxæmia	First seen by Johnson, March 15, 1900, died Sept. 11, 1900. During course of disease tracheotomy for suffocation. Thought by some to be abscess.

S. spontaneous E. erosive T. traumatic

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ANOTHER CASE OF BULLET WOUND OF THE FEMORAL ARTERY AND VEIN SUCCESSFULLY TREATED BY LIGATION OF THE ARTERY AND VEIN AND EXTIRPATION OF THE INJURED SEGMENT*

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BEFORE this association last year and in the *ANNALS OF SURGERY*, March, 1921, I reported a case of communicating bullet wound of the external iliac artery and vein cured by ligation of these vessels above and below the wound; and made a study in detail of the subject of such vessel injuries. This patient's limb has remained in every way normal for two years, save that no arterial pulsation is palpable below the point of ligation.

The present report is of a similar injury slightly lower down in the femoral vessels, though clot formation had closed the fistulous communication. The case was treated by ligation of the femoral artery and vein above and below the site of injury and complete excision of the injured segment involving slightly more than an inch of each vessel. The result is perfect, there is no evidence of ischæmia of the limb, the function of the entire lower extremity is unimpaired, and, but for the absence of pulsation of the popliteal artery and vessels of the ankle and foot and the presence of the scar at the site of operation, there is no evidence that the limb has ever been injured or operated upon.

CASE I.—No. 21-3780, colored woman, about twenty-five years of age, admitted to St. Phillip Hospital September 27, 1921, about 2.15 P.M., having received a pistol bullet wound half an hour before admission. The wound of entrance was in the upper part of the right thigh. There was a wound of exit on the left labium, another one of entrance into the adjacent portion of the left thigh and a final wound of exit in the outer aspect of the left thigh. The wound of entrance in the right thigh was oozing blood. There was some swelling in the right thigh, it measuring $21\frac{1}{2}$ inches in circumference as compared with $18\frac{1}{2}$ inches around the left thigh at the level of the vulva.

Upon admission no pulse was palpable in either foot or in the right popliteal artery. The left popliteal was palpable. An hour later pulsations of the anterior tibial and dorsalis pedis arteries were easily palpable in the left extremity but not in the right. Capillary response in the nails of the left toes was quick and normal; in the right it was slow and subnormal. Needle puncture of the left great toe gave prompt and free bleeding of red blood, from the right the bleeding was slow, scanty and the blood was blue. The superficial veins of the right foot and ankle were slightly distended. The patient complained of great pain in the entire right extremity, most severe below the knee. The toes and

* Read before the Southern Surgical Association, December 15, 1921.

foot were freely movable. There were no abdominal symptoms, the bladder was catheterized, there was no evidence of injury to the urethra or bladder, palpation failed to find any injury of the vagina or rectum.

After five hours, and a hypodermic dose of morphine, there was some subsidence of pain but still no palpable pulse in the right foot, ankle or popliteal space. There was no thrill nor bruit in the region of the femoral vessels nor in any part of the extremity.

Six hours after receiving the injury, an oblique incision was made through a clean field (surgical approach) an inch or so below Poupart's ligament. A small amount of clotted blood was removed from the tract made by the bullet; the internal saphenous vein, in the field of operation, was ligated and cut; fat, lymph-nodes and devitalized tissue were excised. The wounded femoral artery was easily identified and was occupied by a protruding clot. This was just below the origin of the profunda femoris branch. Pulsation of the common femoral was obvious in the part of the artery just below the profunda, but there was no pulsation of the profunda nor in the femoral below the point of injury. The artery below the wound was greatly reduced in size. The pulsating common femoral artery was held up on an aneurism needle to have the bleeding under complete control, the clot was removed, free bleeding occurred immediately, and it was noted that the profunda also pulsated after removal of the clot. The femoral artery was clamped just below the profunda branch and well below the bullet wound. The injured segment (about an inch) was excised. Both ends of the femoral artery were ligated.

Up to this time we had not recognized the wound of the vein. From a study of the subject last year we believed, however, that the companion vein should be ligated whether injured or not in a case necessitating ligation of a large artery. Upon examination of the vein it was found that this was also injured and contained a large clot. After removing the clot and clamping the vessel above and below the injury, about an inch of the femoral vein, including the stump of the previously ligated internal saphenous vein, was removed. When this was done there was seen to be a bleeding vein underneath the femoral (evidently a communicating vein) and this was tied. After trimming away the ragged devitalized tissue in the neighborhood, tying small bleeders, getting the wound completely dry, the skin wound was sutured completely without drainage. The other skin wounds of exit and entrance of the bullet were excised and sutured and the patient placed in bed and the right extremity surrounded with abundant external heat.

Convalescence was normal until the fifth day. At this time she had fever of 102° and some swelling of the thigh. Just above the level of Poupart's ligament there was a soft and fluctuating area. The stitches were removed and there was no visible pus even from the suture holes. Through an aspirating needle into the soft swelling above the operation wound, clear amber fluid resembling lymph was removed. This was thoroughly cultured and found sterile. Swelling and fever persisted several days, and though we were never able to get yellow pus nor a culture of bacteria, we believe there was slight wound infection.

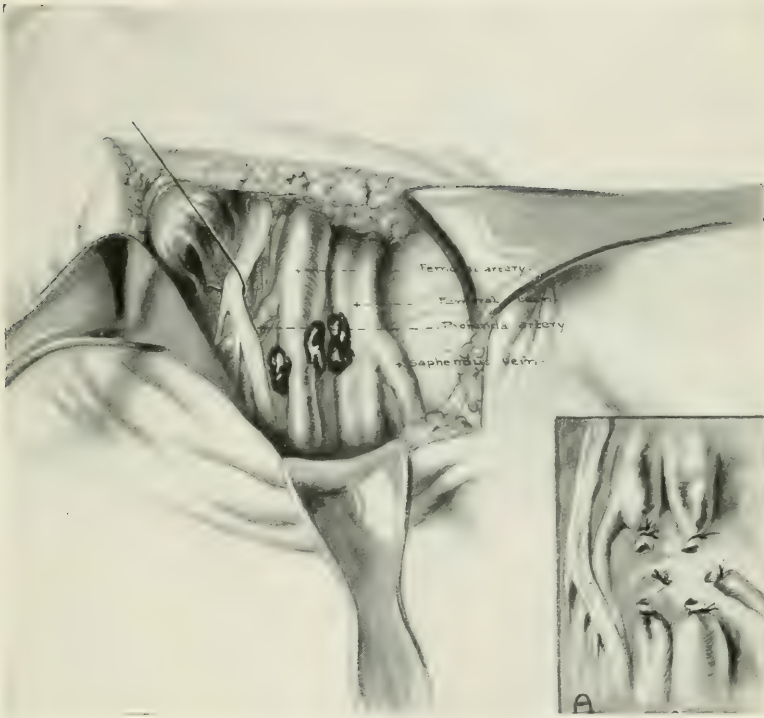


FIG. 1.—Bullet wound of the femoral artery and vein. Insert shows the appearance after ligation of vessels and extirpation of the injured segment.

The woman was discharged after three weeks, walking about and with no disability of any kind. Examination eleven weeks after operation found the extremity in every way normal, except that I was unable to palpate any arterial pulse below the point of operation.

A distinguished American surgeon is quoted as having prayed to be delivered in time of illness from the care of a doctor who has had *a case*. Might he not with equal fervency pray to be delivered from the surgeon whose opinions are firmly fixed after a successful operation upon another case?

When one studies the broad principles involved in the treatment of the immediate and remote effects of injuries of large blood-vessels and the results of isolated and collected cases treated in different ways throughout the world, one can scarcely escape the conviction that for arteriovenous lesions of the external iliac or femoral vessels the proper treatment consists of aseptic excision of the wound or lesion and all that this implies; in other words, ligation of the artery and vein above and below, and extirpation of the involved segment. The large number of cases of arteriovenous fistula on record and the monumental contributions of that great truth finder, W. S. Halsted, leaves little room for doubt that this is the proper treatment for arteriovenous wounds of this character and location and for arteriovenous aneurism or fistula.

NOTE.—I am permitted to say that during October, 1921, I saw Dr. Mont Reid, of Professor Halsted's clinic at Johns Hopkins Hospital, perform exactly this operation upon two cases of arteriovenous fistula of the subclavian vessels, and in both cases the results were perfect cure of the fistulæ and a perfect circulation in the extremities. These cases with others involving other vessels will be reported by Doctor Reid.

THE VALUE OF DAKIN'S SOLUTION IN THE TREATMENT OF ACUTE AND CHRONIC OSTEOMYELITIS

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IN this communication the discussion will consider only those ordinary cases of acute and chronic osteomyelitis which are due to the common pyogenic bacteria, especially the various strains of staphylococci and streptococci. No case due to infection with the tubercle bacillus, syphilitic virus, or other extraordinary cause is considered. Cases of osteomyelitis due to infection with the typhoid bacillus can, from the surgical point of view, be classed with those due to staphylococci and streptococci.

Sufficient time has now elapsed since the establishment of the antiseptic (Carrel-Dakin) method of wound disinfection to enable a fairly accurate judgment of the real value of this method in the post-operative treatment of acute and chronic osteomyelitis. Especially important is the determination of the possibilities of this method in the prevention, or, at least, in the diminution of the frequent recurrences to which osteomyelitis is subject.

For a proper understanding of the subject under discussion a review of some of the underlying essential characteristics of osteomyelitis—its pathologic phenomena, its methods of treatment, the vagaries to which its healing is subject and the causes which frequently determine the non-healing of the wound—is necessary.

For practical purposes acute pyogenic inflammations of bone can be divided into (1) the group in which the major part of the process lies on the surface of the cortex and between the latter and the periosteum; (2) the group in which the process is fairly limited to the bone medulla; and (3) the group in which the bone is diffusely involved. In practical surgery the cases in group 3 have many similarities to those in group 2.

1. The cases in the first group—the so-called subperiosteal abscesses—are characterized by a suppurating focus between the cortex and the periosteum with little or no, permanent damage either to the layers of the periosteum or to the superficial layers of the cortex. When the abscess has been properly incised and drained the usual course of affairs includes a fairly prompt retrogression of the process and a healing of the wound within a reasonable length of time. In exceptional cases the little damage to the cortex results in the sequestration of a small fragment of dead bone which impedes the healing only in an inconsequential degree until the fragment is extruded. Subsequently it is very uncommon to have any further trouble from the focus. Subperiosteal abscess of this kind has many resemblances to abscesses in the soft parts of the body.

2. Medullary osteomyelitis is limited to the medullary cavity of the bone. In acute infections it is almost certain that the process involves primarily the entire medullary cavity and becomes limited later, if at all. Abscess and granulation tissue take the place of the normal medulla. Thrombosis of the vessels is an important part of the lesion. In only a very small minority the process finally localizes itself into a comparatively small, well-demarcated focus, which it is fairly easy to drain completely, or to excise in toto. Then, healing, under the proper care and environment, proceeds as it should from the bottom of the cavity and the latter, once it has cicatrized, remains closed permanently. These are the exceptional cases. Several distinct foci in a single bone can form in this way.

In clinical surgery the remaining cases, composing by far the greatest majority, are known: (*a*) by a lack of macroscopic characteristics which are sufficient to enable the competent operator to accurately make out the limitations of the process; (*b*) by the tendency to sequestrate necrotic bone; (*c*) by the tendency to retain foci of infection; (*d*) by the difficulties in healing especially those due to mechanical causes; (*e*) by their many recurrences.

The frequency with which a blood infection is associated with an acute bone infection is an important factor in our problem. The local focus in the body continuously attracts to itself bacteria circulating in the blood. It is not always necessary for a demonstrable bacteriæmia to be present; there are many cases—commonly known to everybody—in which several foci in widely separated regions of the body have developed subsequently to one another. In these the mechanism has, undoubtedly, included the presence of bacteria in the blood, but, nevertheless, the latter are not demonstrable in the blood cultivations.

3. Group 3 contains the cases which are probably always due to a localization following a general blood infection. It includes the cases with abscess between bone and periosteum as well as in the bone itself and those in which an entire shaft dies and sequestrates.

It is important to remember that it is not always possible to distinguish infected from non-infected bone tissue when operating for osteomyelitis. In the acute cases this is especially true. If the bone be opened in a sufficiently early stage of the disease there may be difficulty in recognizing that any infectious process is going on; and in any case of acute osteomyelitis it is not possible to outline accurately where the diseased area begins or ends and where it approximates to healthy tissue. The difficulties are made greater by the fact that the thrombosis of the vessels, which necessarily accompanies the inflammatory process, extends to a greater distance than that macroscopically visible in the actual diseased area. Under such conditions the possibility is always apparently present for the process to spread and for further destruction of bone to go on. When the thrombus is sterile the latter takes place

because of the deprivation of blood supply. When the clot is infected the process may extend because of the growth of the infection. The operative trauma itself undoubtedly causes the death of certain portions of bone tissue and probably this disability aids and abets the sterile or infected thrombus in extending the process subsequent to the primary operation. In one patient the physical appearances of the additional bone destruction almost made it appear as if a new focus had developed close to the primary one. The notes of this patient follow:

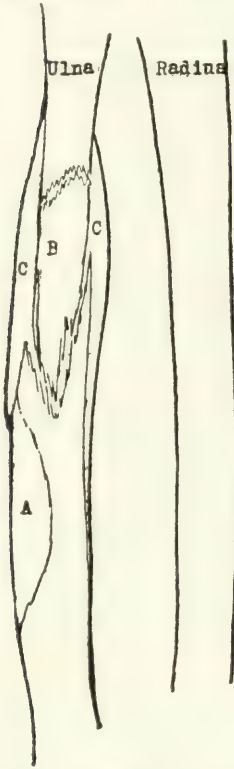


FIG. 1.—Tracing from X-ray picture before secondary operation. A, site of primary osteotomy; B, site to which process spread with sequestrum; C, involucrum.

In a young girl an acute osteomyelitis developed in one ulna. The process seemed limited and a radical osteotomy was immediately done; the wound was then packed wide open. On the tenth day the packing was removed and the lips of the wound strapped together. Agglutination of the wound surfaces rapidly took place and the wound apparently healed with exception of a superficial sinus. Two weeks later the wound became reddened and inflamed and an X-ray picture showed that at one extremity of the osteotomy the process had spread further down and that a sequestrum had formed (Fig. 1).

In clinical surgery this accounts for the practical inability to do a radical osteotomy and to remove all of the diseased tissue in all but an exceedingly small number of the cases of acute osteomyelitis. Such a state of affairs has led many men to advocate doing only a drainage operation at the first sitting and to reserve for a subsequent opportune moment the radical operation. By the time of the latter it is hoped that the infection will have been controlled and that the diseased area will have become sharply demarcated from the healthy tissue even to the extent of a complete separation of the dead bone as a loose sequestrum.

Chronic osteomyelitis and the persistence of bone sinuses are due to several broad causes: (1) The persistence of infected areas of bone; (2) the retention of sequestra; (3) the presence of mechanical conditions which do not permit closure of the wound; and (4) the presence of complicating conditions.

1. Infection may persist, first and foremost, in small infected thrombi in the vessels of the immediate neighborhood of the diseased area. This is a very important item. As already previously referred to, these sources account for the spread of the process to other areas of the same bone, for blood infections and for secondary foci appearing elsewhere. They are

almost impossible to eradicate as any excision is almost certain to be followed by new thromboses.

Infection may persist in small foci, containing a few bacteria, retained in the depths of the scar tissue with which the wound cicatrizes, in the granulations of some of the cells of the cancellous bone or in small pockets of the wound which are formed by premature adhesion. They may lie quiescent for long periods of time and light up for no apparent reason or because of some trauma.

2. The retention of sequestra is very common. It is a frequent finding, also, for the sequestrum to make itself perceptible at a comparatively late period.

3. Mechanical conditions in the wound are the most important reasons for the failure of an operated case of osteomyelitis or for a bone sinus to heal. Among them one distinguishes the following:

a. In a certain number a bone abscess is present which drains into the soft parts through a small perforation. Insufficient drainage being present, the wound naturally does not heal.

b. In some of the latter group an osteotomy has already been done, but at the secondary operations it is found that the area of bone excised does not include the perforation in the cortex.

c. In other cases a canal is present, passing directly from one to the other side of the limb and lined on two or more opposing sides with bone. An uncollapsible sinus results. This is but an exaggeration of group *b*. Commonly this is due to new bone formation produced from the osteogenetic layers of the periosteum where the latter has been lifted away from the cortex at the primary operation.

d. In some a large bone cavity is present of such extent that it is difficult for the walls to collapse sufficiently for cicatrization to take place. Various plastic operations are frequently found necessary to secure healing.

All of these groups are characterized by mechanical conditions which do not permit healing even if the wound be absolutely sterile.

4. Cases in which some complicating condition deters the healing. I refer especially to those in which joint involvement takes place. The joint discharges find their way out through some hidden direct or tortuous path, which frequently is also difficult to expose, into the region of the infected bone or into the wound and serve as a constant source for the reinfection of the latter. This is a very important cause for the persistence of osteomyelitis wounds.

The unoperated chronic bone abscess forms a group by itself. They result from those untreated simple foci described previously in this communication. It is important to distinguish two varieties. In one because of the long duration of the focus of suppuration, the bacteria die and a sterile abscess results which, when properly opened and emptied, can be closed completely by suture with subsequent healing per primam. In the other the

bacteria persist—even though in a much depreciated condition of vitality—and drainage is necessary. The latter type of case then conforms itself in its characteristics of healing to any of the groups previously described.

The factors which determine the efficacy and success of the antiseptic (Carrel-Dakin) method of wound sterilization include: (1) The removal of all sources from which continuing or repeated reinfection can take place; (2) complete asepsis in the dressings; (3) rigid attention to detail; (4) chemically correct solutions; (5) intimate contact between the infected surfaces and areas and the antiseptic solution. In acute and chronic osteomyelitis these factors display the following characteristics:

1. In cases of acute osteomyelitis the complete removal of all sources from which continuing or repeated reinfection can take place is possible in only a very small minority of the cases in which a sharp localization of the process has occurred. Only in the latter can the diseased area be completely removed. A shallow wide wound results from the operation in which the Carrel tubes can be well disposed and in which the Dakin's solution can be adequately instilled. Sterilization of the wound surfaces is possible under such conditions. As soon as the wound is sterile its edges can be sutured together with an expectation of permanent healing.

It is possible to suture such a simple wound after sterilization before the bone tissue, which has been bared by the chiselling, has been covered with granulations. I illustrate with the notes of the following case:

In a young girl with an acute osteomyelitis of the femur, a typical osteotomy and drainage was done and thereafter the wound was treated with Dakin's solution according to the technic described by Carrel. At the end of a week's time the wound was sterile but much bare bone was still present in the bottom of the wound. It was nevertheless sutured after the bone cavity was permitted to fill with extravasated blood. The wound was entirely healed on the fourteenth day and has remained healed up to the present.

In the other cases of acute osteomyelitis the very nature of the pathological process precludes these possibilities. The previous part of this discussion indicates that it is frequently impossible because of lack of recognizable characters, to completely remove the diseased tissue, to guard against the formation of subsequent sequestra, to remove completely all infected thrombi, to prevent or control blood infections—all of which are potent and potential causes for the continued reinfection of the wound. So that from the very nature of things the antiseptic method cannot be successful in the greatest number of cases of acute osteomyelitis.

In discussing the reasons for the failure to heal or for the many recurrences in cases of chronic osteomyelitis, I pointed out that they were essentially of a mechanical nature or were caused by uneradicable foci of infection. In the first of these two the use of Dakin's solution cannot improve the mechanical conditions present. In the second, the structure of bone tissue

prevents the successful intimate contact between solution and infected area—be the latter in the cells of the cancellous bone or in the thrombi—and the method does not succeed in sterilizing the infection. In either case it appears that radical surgery is primarily needed to remove completely these faults in structure or to eliminate entirely the infected tissue, both of which desiderata are essential to the correct and successful technic of the antiseptic (Carrel-Dakin) method.

In neglected cases with complicated sinuses, or with comparatively large cavities in the soft parts or within the bony tissue, the sinuses and cavities become filled with soft masses of badly looking granulations in which bacteria of all kinds flourish abundantly. No antiseptic solution can successfully cope with such an infection existing as it does both on the surface and in the depths; so that, again, the antiseptic method cannot be successful until all of such tissue be completely removed.

Great difficulty is found in a group of cases in which apparently the mechanical conditions for healing seem to be in a satisfactory condition but in which, nevertheless, healing does not take place. I have had cases of this kind in which the bone was covered amply with granulation tissue which was apparently in healthy condition, and in which no bare bone could be discovered anywhere. I have had other cases in which the walls of the cavity were formed, either in whole or in part, by bared bone tissue which was continuously crumbling from a molecular necrosis. Dakin's solution seems to have no effect. Simple curetting of the bone does not seem to have any permanent effect and rather soon the process repeats itself. The trouble seems to be a persistent infection. A radical removal well into healthy tissue is the only procedure that is of value with or without some plastic procedure.

In both acute and chronic osteomyelitis the presence of the complications noted previously defeats the purpose of the antiseptic (Carrel-Dakin) method unless the source can be eliminated. In osteomyelitis these are essentially (1) a communicating undrained or badly drained joint and (2) a blood infection. An undrained or badly drained joint plays the same rôle in osteomyelitis that a communicating broncho-pulmonary fistula does in empyema thoracis; each must be corrected before any sterilizing effect can be exercised by the antiseptic solution. Up to the present there is no adequate method of controlling any blood infection.

2. A very rigid attention to asepsis in the dressings of the wound is naturally extremely essential. It is futile to make use of an antiseptic solution if with each dressing the wound is contaminated anew from the outside.

3. A rigid attention to detail is also essential. All of the factors indicated as being necessary to the proper performance of the Carrel-Dakin technic are essential and any deviation, however slight it may be, causes a breakdown of the entire method.

4. Chemically correct solutions are necessary.

5. An intimate contact of antiseptic solution and area to be sterilized.

It is necessary that the solution have the requisite content of chlorin. In

bone wounds the added difficulty exists that the chlorin must penetrate to a fair distance into the cancellous bone besides covering the surface. The sterilization of one of these two without that of the other will not be sufficient and I have no doubt that one of the important causes why the method fails in some of the bone wounds which have been adequately and correctly prepared is the inability of the chlorin content to penetrate sufficiently deep. There is the further added possibility that the chlorin content of the antiseptic solution may have been dissipated or evaporated from the solution by the time the penetration has occurred.

It is usually said that an absolute sterility of the wound, as determined by the various methods recommended—both smear and culture—is not necessary for the final stage of the Carrel-Dakin technic, namely, for the secondary suture. In bone wounds resulting from osteomyelitis this is especially true. It has repeatedly been possible to suture the wounds secondarily when smears and cultures show that a minimum number of bacteria are present (one organism to three to five microscopic fields in the smear). This, however, corresponds very accurately with the possibilities that are present when the technic is not employed. I have had quite a number of cases in which after the requisite thorough osteotomy the wound was packed wide open and allowed to granulate under the packing until the surface was very healthy looking to the naked eye. Then the lips of the wound were strapped together with adhesive and the wound was left undisturbed for from seven to ten days. At the end of that time it was found entirely healed, or with only a superficial scabbing where the approximation had not been perfect. Smears taken from these wounds at the time of the strapping showed that organisms were present, and, in many of them, their number exceeded that accepted as the orthodox minimum for the secondary closure after the use of Dakin's solution.

On the other hand, the retention of these very few bacteria may account for a certain number of the recurrences. For the bacteria, few as they are, when encysted in the tissues of the wound, are liable under the proper stimulus to assume a renewed activity and cause a subsequent suppuration and reopening of the wound. The latter sequela is possible, naturally, with or without the use of Dakin's solution, and I have personally had experiences with each showing that, at least in this regard, the Carrel-Dakin method has no superiority in osteomyelitis wounds.

For the purposes of this discussion and for my deductions I shall assume that the technic of the antiseptic (Carrel-Dakin) method is properly and efficiently employed as far as is humanely possible. Under these conditions it behooves one to take cognizance of the sources of failure, which are inherent because of the nature of the diseased process in a tissue as peculiar as bone, or because of its accompanying blood infections, in the limitations of one's operative technic in bone tissue, in the disabilities which are present because of associated complications—notably the joint infections—or to other conditions which can secondarily appear during the course of the healing,

as well as of the possibilities which are present when the antiseptic (Carrel-Dakin) method is not employed.

From the foregoing analysis of the clinical conditions it seems, therefore, that in actual practise the antiseptic (Carrel-Dakin) method of wound treatment, as an adjunct in the post-operative treatment of osteomyelitis has but a limited use. The method is useful in only the simplest of the acute cases, in those of small size, in those subjected to an immediate radical osteotomy and in which no further spread of the infection and no subsequent necrosis of bone appears, in those in which the operative wound has a simple contour and is uncomplicated with complex sinuses. In the chronic cases the same may be said only when the conditions approximate those of the simple uncomplicated acute cases.

The method is not successful in any case, either acute or chronic, in which the infection is not entirely eradicated, in which there are adverse mechanical conditions (bone cavities, sinuses or canals) which do not permit cicatrization under any condition, in which complications (joint infections) coexist which are not properly cared for, or in the presence of acute and chronic blood infections.

It seems further that osteomyelitis cases in order to be properly prepared for the correct use of the antiseptic (Carrel-Dakin) method must be subjected to radical surgery in the maximum degree in order to obviate the inherent disabilities outlined previously which by themselves would hinder the healing. After such efficiently done radical operations the wounds resulting must needs have a simple outline and a regular contour and they usually permit an immediate obliteration of the wound cavity by the proper provision and placing of the adjacent soft parts. Under these conditions the antiseptic (Carrel-Dakin) method is superfluous; for, when the after-treatment is properly carried out and one gives an equal attention to the detailed care of the wound, it is possible within a comparatively short time (in my own experience within seven to ten days) to strap, or suture, the lips of the wound together with the confident expectation that an agglutination of the wound surfaces will take place and an efficient healing will follow which equals, in its rapidity and permanency, that obtained after the primary suture of an uninfected wound, and many times exceeds in rapidity that obtained after the use of the antiseptic (Carrel-Dakin) method.

It follows, also, that, other things being equal—as outlined in the previous paragraph,—the antiseptic (Carrel-Dakin) method has not, in my experience tended to give a shorter period for the healing and convalescence.

Under any condition the antiseptic (Carrel-Dakin) method has not seemed to give any assurance that a recurrence of the bone lesion will not subsequently take place. The healing of any bone wound is beset with many opportunities for the retention of dormant foci of infection or for small aseptic sequestra, or for other factors which are always competent under the proper stimulus and environment of causing secondary inflammatory reactions in the neighborhood of the original wound. These sources seem, at the present writing,

to be beyond human powers of prevention. In this regard there does not seem to be any difference in result between the ordinary and the antiseptic (Carrel-Dakin) methods of after-treatment. The notes of the following case will illustrate this point:

The patient was operated upon many times for an osteomyelitis of the femur. At the last one, a very radical osteotomy was done and at its conclusion the wound seemed ideally suited for the antiseptic (Carrel-Dakin) technic. This was instituted; the wound was very promptly sterilized and secondarily sutured. The wound then healed at once and it was hoped that it would remain healed permanently. However, our hopes were not realized; the wound remained healed for a number of months only; then a small sinus formed. An X-ray picture, taken after the injection of bismuth, showed that there was a large cavity and a probe demonstrated the presence of much bare bone.

There are other foci in this patient, one especially in the opposite femur which had not been treated with the antiseptic (Carrel-Dakin) method.* As far as recurrences go, there has been no perceptible difference between any of them.

Closure of the operative wound in acute and chronic osteomyelitis occurs very often as a temporary phenomenon. This can be a matter of a few days, or one of weeks or months. Indeed closure of any wound resulting from any osteomyelitis is commonly accepted as such and its reopening at some subsequent time is taken almost as a matter of course in medical circles. Nature's attempts at compromise are so marked that superficial healing is many times permitted to take place before the deep parts of the wound and its adjacent tissues are quite ready. It is most important to remember this.

SPIRAL FRACTURE OF THE TIBIA AND FIBULA*

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PRACTICALLY all text-books of surgery mention spiral fractures of the tibia and fibula in a manner to note that such fractures occur and that the ends of the fragments are oblique, but rarely is one given to understand that such fractures have a definite mechanism of production and constitute a peculiar problem in reduction and fixation. Failure to appreciate the classical picture of this fracture has led to much mal-union, refracture and deformity and entailing economic loss and has furnished the reason for this report.

The spiral fracture is always produced one way. While the patient is walking and his weight is on the injured leg, he is thrown off his balance, and in endeavoring to regain his equilibrium he twists his leg while bearing his weight on it. This movement breaks the tibia in the lower third and the fibula somewhere in the upper third—the line of fracture being spiral (Figs. 1 and 2). A very complete qualitative and quantitative analysis of the forces operating in producing spiral fractures has been made by Rixford.¹ Since the line of fracture in the tibia is oblique, the weight of the body forces the fragments past each other, causing the entire body weight to be borne on the fibula and sometimes impacting the fracture in it firmly.

When first seen a fracture of the tibia is usually diagnosed with ease. The deformity, mobility and ecchymosis at the site give conclusive evidence of a fracture, but the slight preternatural mobility of the tibial fragments may give rise to the error that the tibia alone is broken. A radiogram of the lower leg only will reveal no fracture in the fibula, but will almost invariably show slight overriding and lateral displacement of the tibial fragments, which is conclusive evidence that the fibula must be broken somewhere outside the field of the radiogram. If a second plate be taken showing the leg from the knee down, the fracture of the fibula will be seen within the first three inches from the head. This fracture can also be predicted by the point tenderness below the head of the fibula. If an attempt be made to overcome the overlapping of the tibia by traction under the fluoroscope, one is soon shown the futility of such attempts. In some of my cases I have given an anæsthetic and placed the leg in a Thomas splint, the end of which I braced against my chest so that I could make effective counter-pressure. With all the traction I could bring to bear, meanwhile watching the fragments under the fluoroscope, I have never been able to extend sufficiently to permit the overlapping tibial fragments to come together.

In one case in which operative treatment was refused, I imbedded the prongs of ice tongs just above the malleoli and heavy continuous traction

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was made for several days, when a second radiogram showed no improvement in the relative positions of the two oblique surfaces of the fracture of the tibia. I have become convinced that in the common type of spiral fracture of the tibia and fibula the fracture of the tibia is not reducible by any conservative means. If any doubt of this remained it would be dispelled by the difficulty one encounters when he operates on spiral fractures. In such cases the only procedures which have been attended with success have been either an osteotomy of the fibula on a level with the fracture of the tibia where the lower fragments of the tibia can be pulled down, or Lowman clamps are applied to the two fragments of the tibia, and these are forced apart with a Gerster turnbuckle.

Since reduction of a spiral fracture is in every case within my experience impossible, the surgeon has the two alternatives of permitting union to take place with the fragments of the tibia in greater or less malposition, or performing an open operation. If the first course is followed union will practically always follow but function will be delayed, for the following reasons:

1. Since the fracture is oblique and reduction with engagement of the ends is impossible, weight-bearing must be withheld until firm bony callus is formed, a period of at least eight weeks.

2. The prolonged fixation of the ankle necessary in splinting the fracture will result in more or less temporary ankylosis of the joint and some time must elapse before a comfortably movable and useful joint can be obtained.

If firm union results there is always some shortening, not less than one-fourth inch, and rarely more than three-fourths of an inch, but in either case it is sufficient to cause a temporary limp until the patient can learn to compensate. Then since the fracture line is long and the ends not accurately coapted, union must depend on a large quantity of callus, and this causes a permanent swelling low in the ankle where it frequently interferes with the fit of the shoe. For the above reasons I have come to regard open operation as the best means of assuring the patient the earliest return of a functioning limb and a perfect final result, and this type of break suggests one of four methods of fixation: (1) Plating. (2) Intramedullary dowel. (3) Bone screws. (4) Banding. Plating has undoubtedly become the most commonly used method of open fixation, but is objectionable here because it necessitates placing a rather large mass of metal beneath skin only where subsequent injury may cause ulceration which may expose the plate. Then since screws in bone loosen easily, external splints must also be used, which temporarily fix the ankle-joint.

The intramedullary dowel is a certain means of fixation and its use in this type of fracture has been strongly advocated by Davison.² In his procedure he does an osteotomy of the fibula in order to obtain the necessary mobility of the tibia for reduction and emplacement of the dowel. This necessitates an extra incision and makes a second fracture to unite. To mobilize the tibial fragments sufficiently to insert the dowel considerable

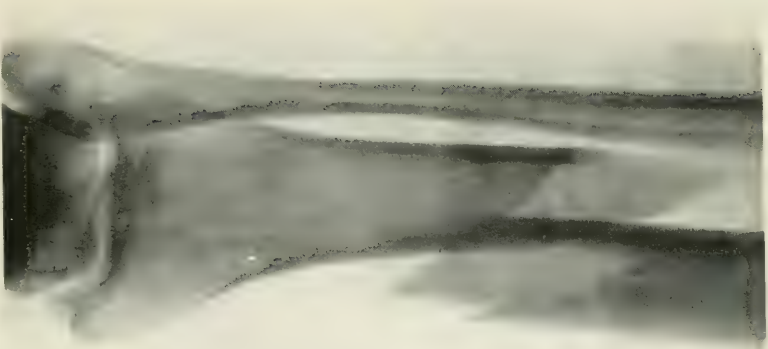


FIG. 1.—Case IX. F 2435. Spiral fracture of tibia. Fracture of fibula as usual does not show in radiogram taken of tibial fracture, but the shortening of one-half to three-fourths inch indicated by radiogram is proof that the fibula is broken at some point.



FIG. 2.—Case IX. F 2435. Radiogram taken same time as Plate I, showing fracture of fibula just below knee.

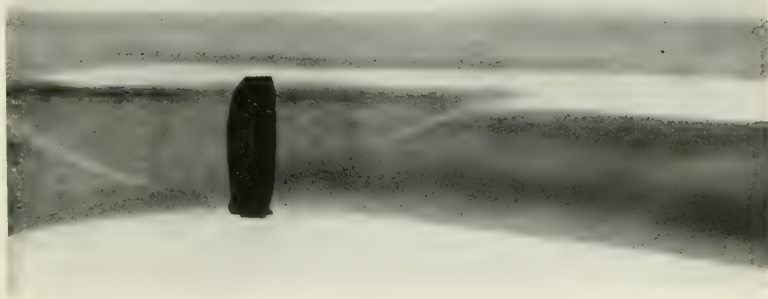


FIG. 3.—Case IV. F 2740. Plate 2. Taken after band was applied. No splint was applied, but leg was laid in a wire basket for ten days. In eight weeks band was removed at which time patient was walking comfortably.

trauma to soft tissue is necessary. Then finally a cast or other means of external splinting is necessary.

The bone screw as popularized by Henderson³ is an excellent means of bone fixation and is well adapted to this fracture, provided there is no splitting or comminution of the lower fragment. This complication renders a screw unsuitable. It is also open to the objection that outside splinting is required.

To my mind the ideal means of holding the fragments in the spiral fracture is the Parham-Martin band⁴ (Fig. 3). A light band, applied tightly after a perfect reduction, will hold fragments so firmly that no cast or splint need be applied and the ankle-joint can be moved as soon as operative soreness has subsided. The band can be applied with the minimum amount of trauma to soft tissue and in a shorter time than any other fixing device. I have now banded ten of these fractures in the past two years and I feel that by this means the period of disability is shortened, and, because the coaptation of fragments is absolutely accurate, union takes place with the minimum amount of callus, so that no swelling of the ankle results.

Since I have been convinced that any attempt at disengaging the impacted ends of the fractured fibula is futile, I make no attempt at reduction or improving overlapping or malposition of the tibial fragments before operation. The pre-operative period is about ten days, at which time swelling has begun to subside and phagocytosis is well established. During this period a well-padded basket splint or Stimson dressing is applied and the leg is kept well elevated. Every effort should be made to maintain the integrity of the skin because vesication or maceration absolutely necessitates postponement of the operation.

The operative technic pursued is as follows: I do not use a constrictor, for I feel that while it makes the operation easier, one often has deep and troublesome bleeding after the operative steps are completed and a hæmatoma may result. After the skin incision is made the knife used is discarded and the undraped skin is covered by towels clamped to the wound margins. After the bone is exposed and the muscle freed, Lowman clamps are applied with a Gerster turnbuckle between them and the fragments are forced apart and placed in perfect position and are held there with Lane bone forceps. I have had made an instrument for passing a Parham-Martin band which I have found a great convenience and time-saver (Fig. 4). It resembles a right-handed aneurism needle in which the blade is about one-half inch wide and is channelled on the concave surface with a channel wide enough for the band to pass easily. This instrument is passed around the bone and the band is pushed through the channel, the Parham-Martin instrument is attached and the band is drawn tight and cut off.

I always advocate the removal of the band in two or three months. This can easily be done under local or gas anæsthesia and requires not more than

one or two days hospitalization. Most of my cases have not accepted this advice and have continued to wear the band without inconvenience. I believe that a plate or band on the tibia is best removed after it has served its purpose, because it is in a position where the overlying skin is easily injured and an injury may cause ulceration to the metal and deep infection may result.

I have treated ten cases of this type in the past two years; of these, two have refused operation, and their subsequent history and present state makes a valuable contrast to the operated cases. In one operated case fulminant infection developed within twenty-four hours, necessitating complete reopening of the wound and removal of the band. This patient finally got a good result. In one case a bone screw was used, and after it was inserted it was discovered that it was fastened in a partially detached fragment and a band was applied in addition. This patient was a pronounced alcoholic, and while the operative result was perfect, operation was followed in two weeks by pulmonary embolism, which was succeeded in turn by left crural phlebitis, then

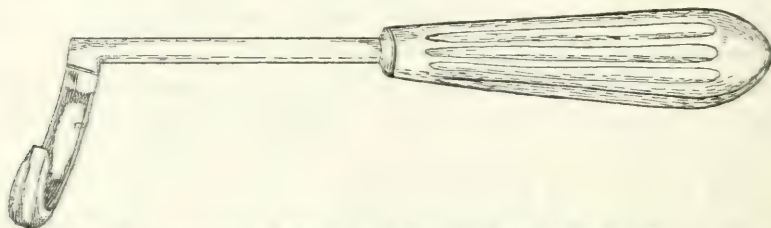


FIG. 4.—Instrument to facilitate passing Parkes-Martin band about bone.

a similar phlebitis on the right side and then a second phlebitis on the left. He finally left the hospital in four months with no impairment other than slightly cedematous legs.

Here follows a brief abstract of the history, course, treatment and results of the ten cases. All cases reported were from the surgical service of the Cincinnati General Hospital, where the patients are all indigent and have no fixed homes—consequently I have been able to obtain late observations in but seven. However, in the three cases in which late record is missing, the hospital residence was long enough to enable a final outcome to be predicted with fair accuracy.

In the series were two surgical mishaps. In the case in which pulmonary embolism and phlebitis followed, sepsis, the only known preventable cause, was absent, for the course of wound healing was aseptic. The one case of infection was a true surgical catastrophe, one of the sort which is possible in every open bone operation and which to some extent justifies the stand which many surgeons take against open bone work. The cause of the infection was not ascertainable. The operation was not difficult and was one of the late ones of the series, so that technic was established and the work was done in unusually short time. I mention these points particularly to emphasize the ever-present peril of infection where a bone is exposed. To reduce this peril to its least liability, I insist on the following technical points as

essential: (1) Minimum trauma of soft tissue. (2) Elimination of possibility of indirect contact with patient's skin by wound guarding. (3) Avoidance of hand contact. (4) Short operating time—probably the most effective preventive of infection.

RECORD OF OPERATED CASES

CASE I.—D 7051, W. C. Male, aged forty-seven. Injured October 29, 1919. Radiogram shows spiral fracture of the tibia in the lower third and fibula in the upper third. A Thomas splint with extension was applied. Shortening one-half inch. Operation November 11, 1919—Parham-Martin band applied and leg was splinted with a plaster cast.

December 9, 1919, band was removed, at which time union was firm. This patient has been seen repeatedly since the operation and he has had perfect restoration of function and no discomfort.

CASE II.—E 752, M. M. Female, aged twenty-eight. Slipped on an icy pavement January 26, 1920. Radiogram shows typical spiral fractures of tibia and fibula. Operation was refused but ice tongs were imbedded just above malleoli on January 29, 1920, and extension was made by Thomas splint. On February 3, 1920, the tongs were removed because radiogram showed no improvement in position of fragments and a cast was applied. On February 19th, patient left the hospital against advice and I saw no more of her till October, 1921, when she called to see if something could not be done to relieve the pain she suffered in the injured leg. She stated that she had not been able to resume her position as saleswoman till September of the year she was hurt and since then she required frequent rest and relief from her work in order to work at all. At this time the radiogram showed firm union with moderate callus and good position but marked atrophy from disuse. There was still one-half inch shortening.

CASE III.—E 2409, S. B. Male, aged fifty. Admitted March 20, 1920. The X-ray shows a spiral fracture of the tibia in the lower third with fracture of the fibula in the upper third. This patient refused operative treatment. Fluoroscopic reduction was ineffectual and Stimson plaster dressing was applied. On leaving the hospital May 6, 1920, the following condition was noted. Shortening one-half inch. Movements of ankle joint restricted (on account of inclusion of ankle in cast). The ankle was considerably enlarged by deposit of callus and there was slight eversion of the foot. There has been no later observation of this patient but he is reported to walk with a slight limp.

CASE IV.—E 2749, H. E. Male aged forty-eight. Was injured March 30, 1920, in a motorcycle accident and admitted the same day. There were typical spiral fractures of the tibia and fibula and in addition a second fracture of the fibula at the same level as the break in the tibia. A Parham-Martin band was applied April 8, 1920, and the leg was kept in a basket splint one week, after which time the patient was allowed up in a wheel chair. He left the hospital April 28th, with quite firm union. On June 13th, the band was removed under short nitrous oxide anæsthesia. At this time contour of ankle was normal, union was firm and the patient got about without discomfort.

CASE V.—E 3176, O. S. Male, colored, aged forty-nine. Admitted April 15, 1921. Radiogram showed typical spiral fractures of tibia and fibula and measurement disclosed shortening of three-fourths of an inch. A band was applied April 22, 1921, and leg was placed in a basket splint.

Patient was discharged May 24, 1921, at which time there was firm union. He did not return for removal of the band as directed. He was seen and examined

November 17, 1921, at which time the leg and ankle were normal save for a slight lump at the site of the band. There was no functional impairment.

CASE VI.—E 8137, M. R., aged forty-nine. Patient was admitted intoxicated November 20, 1920. Radiogram showed typical spiral fractures of tibia and fibula. Operation November 29, 1920. The plan was to secure fragments with a bone screw. After this was inserted and drawn tight it was discovered that a loose fragment only had been secured to the upper end. Complete fixation was then made with a Parham-Martin band. Convalescence was satisfactory till December 23, 1920, when patient complained of severe pain in right lower chest. A pulmonary embolus was diagnosed. On January 4, 1921, he developed a severe phlebitis in the left thigh, which gradually subsided and was succeeded by a similar condition in the right thigh and later a second attack in the left thigh. During this time the wound had shown no sign of infection and had healed by primary union. The patient was bedfast till April 8th, on account of the swelling in his legs. He was discharged April 8th, the swelling in his legs being controlled somewhat by dressings of gauze and Unna's paste. Union was quite firm and there was no deformity.

CASE VII.—F 661, M. B. Female, aged thirty-six. This patient was alcoholic and quite obese. She was known to be syphilitic and there were scars of healed ulcers on both legs. There was a typical spiral fracture of the left tibia and fibula with an open wound and in a few days many large blisters formed. On account of the condition of the skin and the constitutional infection operation was not considered. On February 2, 1921, ice tongs were imbedded in above the malleoli and heavy extension was made with a Thomas splint. After several days extension X-ray showed no relief of shortening. Stimson plaster splints were applied February 13, 1921. Patient left the hospital March 4, 1921, at which time union was not firm. No later report could be obtained.

CASE VIII.—F 881, T. V. Male, aged twenty-one. Admitted February 1, 1921. Classical spiral fracture of tibia and fibula shown by X-ray. Band was applied February 28, 1921—no further splinting. Discharged March 22, 1921, at which time there was firm union without deformity or shortening. No later observation of the patient has been possible.

CASE IX.—F 2435, Female, aged twenty-seven. Admitted March 28, 1921, with classical spiral fracture of tibia and fibula. Band was applied April 7, 1921, with no splint. On April 21st, patient was allowed up and cast was then applied because this patient was feeble minded and could not be trusted. The cast was removed May 20th, and on May 22nd the band was removed. At this time there was firm union and no deformity. Patient was examined in October, 1921, and X-ray taken. Moderate callus is shown. There is no deformity and she gets about without impairment.

CASE X.—F 3737. Male, aged forty-seven. Admitted May 15, 1921, with spiral fractures of tibia and fibula. Band was applied May 24, 1921. Two days later temperature reached 102.4 and the wound was quite inflamed. Drainage was instituted but infection had involved the entire fracture. The band was removed and two months later subperiosteal resection of a three-inch section of the tibia was necessary. At present the wound has healed but there has not been sufficient regeneration of bone to permit weight bearing.

Acknowledgment. The frequently repeated radiograph examinations and attempts at fluoroscopic reduction would not have been possible without the enthusiastic coöperation and help of Dr. Carl Little, director of the X-ray department at the Cincinnati General Hospital.

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VOLVULUS OF THE SIGMOID*

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THE purpose of this paper is to present the subject of volvulus of the sigmoid for your consideration and to report five cases of intestinal obstruction caused by this condition. Volvulus of the sigmoid as a form of acute intestinal obstruction is not as rare a condition as formerly supposed. Briggs¹ states this disease is the cause of acute obstruction in fifteen per cent. There is in these cases, strangulation of the bowel as well as the obstruction of the fecal current. The condition of strangulation makes it much more serious for the patient. The sigmoid flexure is the most common site.

One hundred and ten cases of acute intestinal obstruction from various causes have been operated by me. In this number there were five cases due to volvulus of the sigmoid, making for this series a percentage of four and five-tenths. Authors state in about five per cent., volvulus of the sigmoid is the cause of intestinal obstruction. The 110 cases do not include those due to adhesions causing obstruction following shortly after operation. I here report five cases before taking up the subject of the etiology, the mechanism, the diagnosis, the symptoms and the treatment.

CASE I.—Mrs. J. A. Age fifty-eight, was admitted to my service at Mercy Hospital, August 13, 1914. She came to the hospital complaining of swelling of feet and ankles which began about two weeks previous to this date. At the same time she was becoming constipated and noticed that her abdomen began to enlarge. She has had chronic constipation for years. Sometimes she would not have an evacuation of the bowels for two weeks and then she would have diarrhoea for several days. She had blood in the stools at times. This was attributed to hemorrhoids. She had a pelvic abscess following her last pregnancy. She has lost twenty pounds in the last seven or eight months.

Operation.—August 21, 1914. An incision was made through the right rectus muscle. There was extreme distention of the colon and the sigmoid. The small bowel was moderately distended. A dermoid cyst of the left ovary was found. It was adherent to the broad ligament, the side of the pelvis and the descending loop of the sigmoid. The sigmoid was twisted on its mesenteric axis and turned down into the pelvis. The foot points of the sigmoid were not disturbed. The dermoid cyst was removed and the volvulus untwisted. She died the second day following operation. Her death was believed to be due to a recurrence of the obstruction.

CASE II.—J. G. M. Age forty-four. Male. Occupation carpenter, was admitted to Mercy Hospital at 5.30 P.M. December 11, 1916, being referred to me by Dr. A. D. Price. At 10.00 A.M. on this day while at work the attack began. He was driving a nail above his head, and was bending over backward. I mention

* Read before the Allegheny County Medical Society, December 20, 1921.

¹ Ohio State Medical Journal, 1912.

this fact for the reason that trauma is said to be one of the causes. The attack commenced with colic in the abdomen, left side low down. The colic gradually became worse and very severe, and paroxysmal in character. The distention gradually increased, and at the time of admission to hospital his condition was as follows: The abdomen was greatly distended and was unsymmetrical. Below the level of the umbilicus the abdomen protruded; a furrow was present across the abdomen at the level of the umbilicus and above this the abdomen was pushed out like a balloon, giving the impression of an acute dilatation of the stomach. Pulse 128, temperature 98, general condition good. There was tympany all over the abdomen and no peristalsis was present. The abdominal muscles were not rigid, but were tense. No visible peristaltic waves were observed. He had paroxysms of pain lasting about one minute, at intervals of from five to ten minutes. Two enemata of milk and molasses were given but neither was effective.

Operation.—December 11, 1916. 10.00 P.M. The incision was made through the right rectus for the reason that most of the causes of intra-abdominal intestinal obstruction are found on that side. As soon as the abdomen was opened a great, large, thick, dark bowel presented itself. The incision was then enlarged and an effort made to deliver the bowel. This was found to be impossible. A large aspirating needle, to which was attached a long rubber tube, was inserted into the bowel and a great quantity of gas escaped, after which the delivery of the bowel was made.

Pathology.—The bowel was found to be a distended sigmoid which was twisted on its mesenteric axis, from right to left, two and one-half times. It was dark and gangrenous. Its walls were much thickened and the longitudinal bands greatly broadened.

The diameter of the bowel before aspirating was at least ten inches and after untwisting and being laid on the operating field the apex of the volvulus reached to within six inches of the knee. I estimated that each limb of the volvulus was eighteen inches in length. There was a small amount of fluid in the abdominal cavity, giving off a colon odor. Evidently the colon bacillus had permeated through the bowel wall. The giant sigmoid completely filled the abdominal cavity. All of the remaining parts of the intestines were collapsed and were behind the volvulus. The mesentery of the sigmoid was thickened.

Mechanics of Operation.—The vessels of the mesentery were ligated and the sigmoid resected (angiotribe forceps and cautery method) through the proximal and distal parts of the sigmoid. The ends of the bowel were closed and a lateral anastomosis (clamp method) was performed. Several sutures were then inserted through the ends of the bowel, already closed, to the lateral wall of the descending colon and rectum, respectively, above and below the anastomosis, to hold it more firm. The ligated vessels of the meso-sigmoid lay behind the anastomosis. He made an excellent recovery, having no complications except a slight infection of the lower end of incision, and was discharged from the hospital January 16, 1917.

Previous History of Patient.—In July or August, 1898, he had his first attack of abdominal colic. For this attack he called in Dr. H. O. Huffman of Thomas, West Virginia. At the end of about two weeks Doctor Huffman sent him to the Western Maryland Hospital, Cumberland, Md., where he came under the care of Doctor Miller, who operated upon him for a twist of the bowel.

First Attack after Operation.—Following the operation he was in good condition for two and one-half years (1900) when he had a severe attack of colic with distention. This time he was sent to the Wheeling Hospital, Wheeling, West Virginia, and was under the care of Dr. Gregory Ackerman. Enemata were given there and he was relieved.

Second Attack after Operation.—About one and one-half years later (1902),

he had another attack of colic with distention. This time he relieved himself by the use of enemata and the rectal tube. A year or two later, 1903 or 1904, he had another severe attack and was sent to the Cottage Hospital, Connellsville, Pa. He was there relieved again by enematas. He states that he would be free for a couple of years and then again have a recurrence of his attacks. He thinks that in the last eight or ten years he would have an attack once a year, on an average, but during the last year he had three or four attacks, the most severe one occurring in July, 1916.

Except for the times he entered a hospital for treatment he has always been able to relieve himself by enemata and the rectal tube. In every attack he always had colic with distention. The pain was always the same; the distention would vary. The pain was always first noticed on the left side of the abdomen, low down, and would extend up toward the umbilicus.

The attacks came on always during the day while at work. He does not remember of ever having an attack which began in the night. He believes that he has had altogether twenty attacks. This history is given purely from the memory of my patient. It is interesting for the reason that he, no doubt, has had a chronic volvulus at intervals for years.

He has evidently had a greatly enlarged and thickened sigmoid for years. This enlargement and thickening of the sigmoid made him an excellent subject for recurring or chronic volvulus. The exciting cause, I believe, in this attack, was trauma. His attacks always occurred when he was working. It is my opinion that enough trauma or force can be applied by means of the abdominal muscles to start the twisting of the sigmoid.

This case corresponds closely to one reported by Dr. Joseph C. Bloodgood,² His patient had thirty-two distinct attacks of chronic volvulus.

CASE III.—A. M. Age sixty-six, was admitted to the Presbyterian Hospital February 12, 1918, to the service of Dr. C. W. Morton.

History.—He states that he had been constipated for thirty years. In 1906 or 1907 he had difficulty for the first time in obtaining an evacuation of his bowels and was compelled to resort to enemata and the rectal tube. Since this time he has used enemata and the rectal tube about twenty times every year. The symptoms during these attacks were colic, distention, borborygmus and pain in the small of the back with obstipation. At the time of admission to the hospital, his bowels had not moved for five days. One week before this attack he had experienced much difficulty in obtaining a bowel movement. His symptoms on coming into the hospital were as follows:

Great distention of the abdomen and a large mass was present in the right lower abdomen. He was in good general condition with practically no change in his pulse or temperature. Enematas and some medication were given and eventually good bowel movements were obtained. As soon as this occurred the distention went down and the mass noted before on the right, would be found on the left side of the abdomen. The mass would never entirely disappear although it would leave the right side of the abdomen going to the left.

During the period in the hospital before operation the distention would recur and the mass would extend again to the right side of the abdomen. The diagnosis of volvulus of the sigmoid was made. I saw him the first time with Doctor Morton about the 15th of February. There was a mass, (Von Wahl's sign) present in the left side of the abdomen but as his bowels were open, we decided to wait a few days before operating to allow him to recuperate a little and also to fill him up on fluids. The distention again recurred and after decreasing the distention by enemata, operation was performed.

² ANNALS OF SURGERY, 1909.

While he was going under the anæsthetic marked visible peristalsis on the left side of the abdomen was observed.

Operation.—February 22, 1918. A seven-inch incision was made through left rectus. The sigmoid was enlarged and the walls were thickened and congested. It was thirty inches in length and its largest diameter was about eight inches. It was twisted on itself from right to left. The beginning of the sigmoid was narrowed while the part going into the rectum was much increased in diameter. There were some adhesions on the outer surface of the mesentery of the sigmoid where the descending colon and the sigmoid meet.

The mesentery of the sigmoid was thickened and the blood-vessels were enlarged. The remaining parts of the intestines were not distended.

Mechanics of Operation.—To perform simply a detorsion would not have benefited this man at all and I decided to resect the sigmoid and perform a lateral anastomosis between the proximal and the distal parts of the sigmoid flexure, respectively remaining.

The sigmoid was partially resected (angiotribe forceps and cautery method) and the vessels in the mesentery controlled.

The ends of the divided gut were closed. I attempted to do a lateral anastomosis by the clamp method. I found I had not left enough gut to do this and was forced to employ a Murphy button. I regretted the error in not having enough gut to perform the lateral anastomosis by the clamp method. My error is, I think, easily explained. Before the gut and the mesentery were divided the whole sigmoid could be lifted outside the abdomen. As soon as the resection was completed, the mesentery pulled the intestine inside the abdominal cavity and the intended type of anastomosis could not be done.

Convalescence.—His condition was satisfactory for four days. During this time his bowels moved satisfactorily. On the fourth day he developed obstruction of the bowels, caused, I believe, by too much tension at the site of anastomosis.

It was necessary to make an artificial anus by opening the end of the descending colon or the beginning of the sigmoid through a McBurney incision. He also developed a fecal fistula through the abdominal incision. This has never quite closed and gives him some annoyance at times. His bowels move well through artificial anus. It is remarkable how well he can regulate them. He is today able to follow his occupation, that of a tailor.

While this paper was undergoing preparation this man came to see me. He found that more of his intestinal contents were coming through the abdominal incision than through the artificial anus. The cause of this was due to the gradual closing of the artificial anus. On December 12, 1921, he was given chloroform and the opening of the gut at the site of the artificial anus enlarged with the fingers. I anticipate that this will again make him comfortable. I have noticed in other cases that where I had made an artificial anus through a McBurney incision there was a tendency for the opening to close. The Murphy button fell the wrong way and has never been recovered.

CASE IV.—H. L. B. Male. Age twenty-three, was admitted to my service at Mercy Hospital August 17, 1919, being referred to me by Dr. G. W. Gallagher, of Connellsville, Pa.

History.—He is a rugged young adult and his occupation is that of car inspector. He has always had good health but has been chronically constipated most of his life. He states that when he becomes constipated it is accompanied by general abdominal colic and much gas. By taking a purgative he is relieved of his discomfort. These attacks (colic and gas) usually occurred once a month but sometimes he would not have them for five months. In 1915 he had a severe

attack of abdominal colic lasting one night. His appendix was removed in March, 1917, after which he had no attacks for one year, when they again recurred.

On August 14, 1919, he had an attack which began with severe pain just below the umbilicus. The pain worked its way up to the pit of the stomach and upper left quadrant of abdomen. In all his attacks he had marked pain in the back.

At the time of admission to the hospital his abdomen was markedly distended and his abdominal muscles were tense but not especially rigid. His peristalsis was not lost entirely but was faint. His temperature was about 102° and his pulse was slightly accelerated. Enemata were given but no results were obtained.

Operation.—August 18, 1919. A twelve-inch incision was made through scar in midline of former abdominal section. The sigmoid was found twisted on its mesenteric axis one and one-half times from right to left. It was large, being about fifteen inches long from its foot points to its apex. It was eight inches in diameter at its largest part. It filled the left half of the abdomen. In the descending part of the sigmoid where the twist of the gut occurred the wall was destroyed around its entire circumference. This was close to the beginning of the rectum. Not much remained but the serosa. There were adhesions between the ascending loop of the sigmoid and the parietal peritoneum. There was some fluid in the abdomen. The remaining parts of the intestines were not especially distended.

Mechanics of Operation.—Detorsion was performed and a partial resection of sigmoid done (angiotribe forceps and cautery method) and a lateral anastomosis was made by the means of a Murphy button. In this case it was necessary to go beyond the damaged gut caused by the twist and only enough was left to connect with a Murphy button.

Convalescence.—On September 3rd, eighteen days after operation, some fecal matter and gas came through lower end of incision. At the time of discharge from hospital, September 29th, there was occasional fecal discharge from incision. This condition eventually cleared up and at the present time he is well in every way and is able to follow his usual line of work.

CASE V.—E. K. Male. Age fifty-two, was admitted to my service at Mercy Hospital, November 29, 1921, being referred by Dr. E. W. Weller.

History.—For the past year he has had constipation of gradually increasing severity. He noticed that flatulence accompanied by cramp-like pain occurred more frequently and that larger doses of medicine were required to obtain free evacuation. On arising at 7.30, the morning of November 27th, he had severe cramp-like pains over entire abdomen. He took his usual remedy, cascara, and other medication without effect. The cramp-like pains were more severe than any he had ever experienced and were all over the abdomen. Later the pains disappeared from the right side of the abdomen, but remained in the left. He noticed borborygmus for the first twenty-four to thirty-six hours. He vomited the first time at midnight on Monday, November 28th. Since that time vomiting has occurred more or less frequently.

The pain from the beginning was more severe on the left side.

At the time of admission to hospital his condition was as follows:

General condition good. Temperature and pulse about normal. Leucocyte count 18,000. Blood-pressure 150-90.

The abdomen was distended; tense but not rigid. There was some tenderness over abdomen. The peristalsis was almost absent. There was a localized soreness on the left side of the abdomen just below the umbilicus.

A volvulus of the sigmoid was anticipated, for the reason that the most of his local symptoms had been on the left side as well as a localized tenderness on the same side.

Operation.—November 29, 1921, 3.25 P.M. An eight-inch incision was made

through the left rectus muscle. The sigmoid flexure was found twisted from right to left on its mesenteric axis 180 degrees. It was large, being about sixteen inches long from the foot points to its apex, and at least six inches in diameter at the largest part. The walls of the gut were thickened and congested. The mesentery was also thickened and there were marked adhesions, 3 to 4 inches broad, on its outer surface, midway between the foot points and the apex of the sigmoid. These adhesions were confined to the mesentery (contracting mesenteritis) and drew the sigmoid together. The gut extended up to the liver and practically filled the entire abdominal cavity. The distal part was larger than the proximal part. The foot points were not drawn together.

The remaining parts of the intestines were not distended.

Mechanics of Operation.—The sigmoid was untwisted, and, after a rectal tube was inserted through the anus to allow gas and fecal matter to escape, a partial resection, (angiotribe forceps and cautery method) was done. The resection was made about six inches from the foot points of the sigmoid. This left enough gut to do a lateral anastomosis as well as leaving a part of the sigmoid to again act as a reservoir.

Convalescence.—His recovery was uneventful. He had no complications. Bowel movements for several days before leaving the hospital were normal. He was discharged from the hospital December 15, 1921.

Etiology.—The production of a volvulus of the sigmoid is the result of several causes. The primary cause is, I believe, due to an enlarged sigmoid and which is probably congenital. The next factor of most importance is constipation. Adhesions following attacks of inflammations, operations, and the presence of tumor plus inflammation will play a part.

Bloodgood² mentions adhesions running from the outer surface of the sigmoid and the meso-sigmoid to the floor of the left iliac fossa as a cause. It seems reasonable to me that these adhesions found connected with the sigmoid and its mesentery are the direct result of constipation. Any bowel which is filled with fecal matter (constipated) over a long period will have increase of the thickness of its walls. The thickening can hardly be the result of peristaltic action. The mesentery is contracted as a rule in these cases, and is called contracting mesenteritis. It is, I believe, produced by no other cause than constipation. This contraction of the mesentery draws the foot points and the proximal and distal parts of the sigmoid together and makes it more easy for it to become twisted. Trauma is reported to be a cause.

Predisposing Causes Also are Found.—It usually occurs after forty years. The ages of my patients were as follows: Twenty-three, forty-four, fifty-two, fifty-eight and sixty-six years. It is more common in males—four to one, in my series. A congenital enlargement of the sigmoid is naturally a factor, and is probably always present.

Mechanism of Volvulus of the Sigmoid.—Bloodgood,² in his article, gives a very sensible idea of the mechanism, and I will give you his construction of it. He believes that the dilatation of the sigmoid is present before the first attack. Fermentation with the formation of gas in this large sigmoid he considers to be the first etiological factor. This distended loop of bowel is lifted up into the abdominal cavity. As it rises it produces a kink at its

junction with the descending colon for the reason that this part of the bowel is fixed. This kinking produces obstruction at this point. At this time he states there is no kink in the rectum. Later on, as the dilated sigmoid arises, its upper arm becomes more tense on account of its attachment to the fixed descending colon. The lower portion of the sigmoid and the upper rectum which are less fixed, rise, and as the least resistance is up and to the left, the distended lower portion of the sigmoid and the rectum move in that direction, and the upper portion of the sigmoid is twisted downwards and to the right, while the lower portion moves upwards and to the left, and the twist is from right to left. The twist kinks the rectum and we have a double obstruction.

Diagnosis and Symptoms.—The diagnosis is difficult, but given a case in which there is history of constipation and in which the pain commences on the left side, low down, extending upward as the gut increases in size, with vomiting coming on late, with little or no peristalsis and with obstipation, volvulus of the sigmoid should be considered.

In three of my cases there was but little peristalsis. In these three the sigmoid filled practically the entire abdominal cavity. The remaining parts of the intestines were behind it and consequently peristalsis could not be heard or was very faint.

In Cases II, III, IV and V the pain began on the left side, low down, and extended upward. There was also a feeling of fullness in this region. Marked visible peristalsis entirely on the left side was present in number three. Local tenderness is usually present on left side. There was pain in the back in Cases III and IV. Vomiting comes on late in all forms of intestinal obstruction, occurring low down in the intestinal tract.

The twist in all cases, except No. I, was from right to left. Von Wahl's sign (a tense, smooth tumor in iliac fossa) was present in No. III.

Treatment.—No purgatives are to be given. The treatment is surgical, however; enemata should be first tried. To obtain results they should be given in the knee-chest position. Cases II and III found out for themselves that this position was the best way to obtain relief.

If no result is obtained after one or two enemata surgical interference should be done at once.

The incision is to be made on the left side and volvulus untwisted. It is my opinion that a resection should be done in all cases and not return the bowel to the abdominal cavity, as is the usual custom. In some cases on account of extensive gangrene and poor condition of the patient, it may be necessary to establish an artificial anus or to bring the bowel outside the abdomen and allow it to slough off. To return the bowel to the abdomen after untwisting does not seem to me to be a good surgical procedure. Why return a bowel such as this when it can easily be resected and an anastomosis performed? Adhesions as noted in the etiology may be found. They may be divided. It is a well-known fact that adhesions are most likely to reform and many

times are more strong and dense than the original ones. If they have much to do with the cause of a volvulus of the sigmoid they will again aid the twisting. Nothing can be done with the contracting mesenteritis to avoid recurrence. This contraction causes the proximal and distal tubes of the sigmoid to be drawn together as well as the foot points and renders the twisting more easy. The constipation is not changed by simply untwisting the sigmoid. Even in cases in which the bowel is not viable, and in which there is fluid in the abdominal cavity of colonic odor, resection can be done with safety. In Case II the gut was not viable and fluid in the abdominal cavity gave off colonic odor. It is not necessary to remove the entire sigmoid. It is best to leave about six inches of the proximal and distal parts of these giant sigmoids. A lateral anastomosis can then easily be done. This technic will leave a certain part of the sigmoid to again act as a reservoir.

My belief is that these cases which have recurring volvulus of the sigmoid have had a colon infection of the peritoneum so often that they have formed an autogenous vaccine which enables them to overcome the inflammation. I can see no reason why the risk should not be taken and cure the patient of the volvulus and at the same time of his constipation.

VALUE OF BLOOD-PRESSURE IN ACUTE CEREBRAL COMPRESSION

AN EXPERIMENTAL AND CLINICAL STUDY

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DURING the course of a number of experiments with general increased intracranial pressure,¹ it was noted that there seldom occurred the compensation on the part of the medullary centres which has been described by Spencer and Horsley,² Cushing,³ Naunyn and Schrieber,⁴ Eyster, Burrows and Essich⁵ and others.

A number of workers have noted that the rise of blood-pressure following section of both vagi was greater than before their section when the animal was subjected to increased intracranial pressure. It was also noted by Loevenhart, Malone, and Martin¹ that paralyzing the motor endings of the vagi with atropine under general increased intracranial pressure, in two experiments, caused the vasomotor centre to fail rapidly.

With these facts in mind the present research was undertaken in an effort to ascertain what factors, other than reduced oxygen supply, govern the compensatory rise of blood-pressure following general increased intracranial pressure.

Methods.—Experiments (thirty) were performed on dogs and rabbits under ether anaesthesia. The intracranial pressure was applied to the subdural space by means of a tight-fitting cannula inserted in the skull in the parietal region and the cannula then connected to a pressure bottle which was filled with Ringer's solution. This system was connected to a U-shaped manometer for recording the pressure.

The blood-pressure was recorded by means of the ordinary U-shaped mercury manometer connected to the carotid artery and a pressure bottle. The respiration was recorded by means of a rubber bag bound to the body and connected to a recording tambour. The time was recorded in seconds. When artificial respiration was given it was given with an automatic artificial respiration tank connected to an ether bottle and then to a tracheal tube.

In dogs the response of the medullary centres to general increased intracranial pressure was studied under varying degrees of depth of anaesthesia, with one vagus cut, with both vagi cut or cocaineized, and with motor vagal endings paralyzed by atropine.

In rabbits the same response was studied under varying degrees of anaesthesia, when the depressor nerves were cut, when both vagi were cut and when both the vagi and depressors were cut.

RESULTS

Experimental. 1. Variations in depth of anæsthesia: a. Light third stage ether anæsthesia:—In both rabbits and dogs under this condition there resulted the classical response of the medullary centres to increased intracranial pressure, namely: a rise of blood-pressure, stimulation of the respiration followed by normal rhythm or Cheyne-Stokes breathing, depending upon whether the blood-pressure increase remained constant or periodic as it is so often seen, temporary stimulation of the vagal centre with resultant vagal pulse. The amount of compensatory rise of blood-pressure before the vasomotor centre was fatigued varied in different animals but it was never less than 40 mm. of Hg. The length of time the compensation would last also varied in different animals and in the same animal depending largely upon the degree of increased intracranial pressure to which the animal, was subjected. In no case did the compensation hold longer than an hour unless artificial respiration was instituted when the respiration began to fail. In many of these experiments the response of the medullary centres was absent under deep anæsthesia but returned again under light anæsthesia.

b. Deep third stage anæsthesia (corneal reflex and reaction of pupil to light absent or sluggish). Under these conditions the compensation of the medullary centres to increase intracranial pressure was either entirely absent or very slight and when present lasted only a few seconds. Rapid decompression and artificial respiration was necessary to save the animal. In many of these experiments good compensation occurred whenever the anæsthesia was lightened even though the compensation had been absent under deep anæsthesia.

2. *Effect of Cutting Vagi.*—In some experiments the intracranial pressure was raised until a maximum medullary compensation occurred and allowed to remain at this level for about 5 minutes. One and then both vagi were cut. It was found that the cutting of one vagus rarely changed the degree of compensation but when both vagi were cut the blood-pressure and the lung ventilation increased so that the relative anæmia of the brain was decreased and the animal was able to live much longer than would have been possible had the increased compensation not occurred.

3. *Effect of Paralyzing the Motor Endings of the Vagi with Atropine Sulphate.*—Doses of atropine large enough to paralyze the vagal endings failed to stimulate the respiration and caused a slight transitory rise of blood-pressure, due to removal of the vagal tone, followed by a rather rapidly falling blood-pressure and death. In one experiment both vagi were cut as soon as the blood-pressure began to fall and an increase in blood-pressure, which persisted for some time, followed. Thus it is evident that the loss of vagal tone is deleterious to medullary compensation following increased intracranial pressure, and also that the benefit derived from section of the vagi is not dependent upon the motor fibres.

4. *Effect of Cutting the Depressor Nerves.*—These experiments were carried out in rabbits where the depressor fibres of the vagus are in a separate bundle. It was found that the blood-pressure increased to a higher level after section of the depressor nerves than before and that on section of the vagi no further increase occurred. In experiment 14 the blood-pressure increased from 140 to 190 mm. of Hg before the depressors were cut and from 70 to 170 after the depressors were cut. In experiment 22 the rise of blood-pressure was 35 mm. of Hg more after section of the depressor nerves than before their section. Section of both vagi with depressor nerves intact gave no increase in medullary compensation.

SUMMARY

1. Under light third-stage ether anaesthesia medullary compensation occurs consistently following an increase in the intracranial pressure. This did not occur when the anaesthesia was deep.

2. The medullary compensation to increased intracranial pressure is greater following section of both vagi in the dog or both depressor nerves in the rabbit than with these nerves intact. This was not true when only the vagi were cut in rabbits or when the motor endings of the vagi were paralyzed with atropine. Therefore the cutting of the afferent fibres in the vagi is the important factor in producing the better compensation following section of the vagi.

Clinical.—The depth of ether anaesthesia determines the response of various reflexes, and in the experimental work it was noted that when the anaesthesia was light enough to allow medullary compensation, the corneal reflex and the reaction of the pupil to light was very active. It seemed possible that the loss of pupillary and corneal reflexes under deep anaesthesia was comparable to the loss of these reflexes following intracranial injuries, and therefore there might be some relation between the condition of the reflexes and the ability of the medullary centres to compensate for increased intracranial pressure. The reaction of the pupil to light was selected as a reflex phenomenon to serve as a criterion of the condition within the skull. The corneal reflex should also be valuable, but it was not observed often in the cases studied below.

With this in mind a study was made of records of the cases of cerebral injury seen in Barnes Hospital for the past ten years. There were seventy-eight cases, of which thirty-five had subtemporal decompressions; no fracture could be demonstrated with the X-ray in some of these cases. For the past ten years it has been routine on Doctor Sachs' service to take blood-pressure readings every fifteen minutes in all cases of suspected acute cerebral injury. Some cases, however, had such incomplete records that they could not be used for this study. Therefore thirty cases of the thirty-five cases of decompression were used. The balance of the forty-four cases summarized in Table I are those in which blood-pressure records showed a definite increase in blood-pressure, eye reflexes active, but no subtemporal decompression was done.

TABLE I.

No. of cases	Reaction of pupils to light	Size of pupils	Blood-pressure compensation	No. died	Per cent. died
22	Active	Not dilated	Active for hours	3	13.54
9	Sluggish	Dilated	Fair for few hours	4	44.4
13	Absent	Widely dilated	Little or none	8	61.5

In Table I the results are grouped and are seen to fall in three classes:

1. When the reaction of the pupils to light was active there was a good blood-pressure compensation which lasted many hours, and on decompression

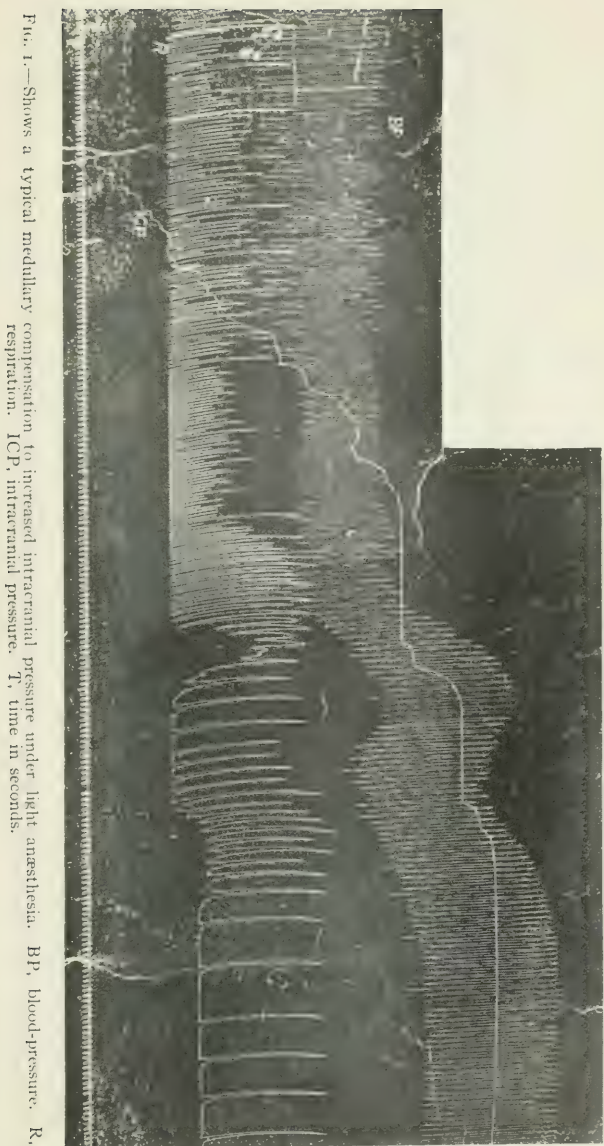


FIG. 1.—Shows a typical medullary compensation to increased intracranial pressure under light anesthesia. BP, blood-pressure. R, respiration. ICP, intracranial pressure. T, time in seconds.

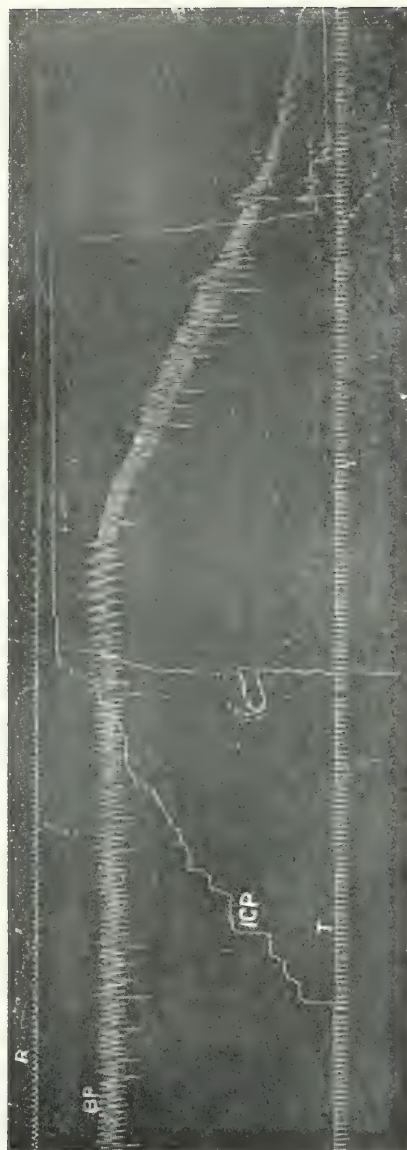


FIG. 2.—Showing lack of compensation on the part of the medullary centers to increased intracranial pressure under deep anesthesia. R, respiration. BP, blood-pressure. ICP, intracranial pressure. T, time in seconds. (Respiratory excursion poor because of leak in tambour.)

the blood-pressure returned to normal and the patient usually recovered satisfactorily.

2. When the pupils reacted poorly to light and were dilated the blood-pressure compensation usually was not as great, was of shorter duration, and even on decompression a much larger percentage of cases was fatal.

3. When the pupils were dilated and did not react to light, there was either no blood-pressure compensation or only very slight compensation of short duration and the mortality was very high.

From this it is evident that the blood-pressure is a good criterion of the severity of the cerebral compression when the reaction of the pupil to light is active or even sluggish and the pupil is not widely dilated. If, on the other hand, the pupil is widely dilated and does not react to light, the blood-pressure is of no service as an index as to the degree of cerebral compression. Also, when the reaction of the pupil to light is sluggish or absent, the prognosis is grave and no time should be lost in relieving the intracranial pressure.

CONCLUSIONS

1. Medullary compensation following increased intracranial pressure is a constant phenomenon experimentally when the anaesthesia is not deep enough to block the corneal reflex or the reaction of the pupil to light, but is absent when the anaesthesia is deep.

2. The depressor fibres in the vagus inhibit the rise of blood-pressure following increased intracranial pressure.

3. Clinically, blood-pressure compensation following increased intracranial pressure is a valuable criterion of the degree of cerebral compression when the pupils react to light, but is of no service when they do not.

4. A sluggish or absent reaction of the pupils to light indicates a grave prognosis and no time should be lost in relieving the cerebral compression.

It has been an almost invariable rule, however, on the Neuro-surgical Service not to decompress a patient if the blood-pressure is falling or is below normal. This has been taken as evidence that the last stage of compression has been reached and that the medullary centres are exhausted and can no longer compensate.

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TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held January 9, 1922

The President, DR. GEORGE G. ROSS, in the Chair

DISARTICULATION OF THE HIP

DR. JAMES K. YOUNG presented a patient, age sixteen, male, who without history of trauma, noted pain in left knee and thigh, December 15, 1920.

On examination by the speaker January 3, 1921, there was swelling of left leg, beginning just above the condyle, reaching its maximum at three inches above and tapering off above that to a distance of four or five inches. Tender, limitation of flexion, knee-pain on motion. No involvement of joint. No pulsation. Wassermann was negative to all antigens. Urine negative for Bence-Jones bodies; decided amount indican, no albumin, sugar or casts. The blood count showed: Red cells, 5,300,000; white cells, 14,700; hæmoglobin, eighty-seven per cent.

Physical examination of chest, few subcrepitant râles both apices. First X-ray January 10, 1921. Periosteal sarcoma starting about middle of femur, involving soft parts and invading shaft just above internal condyle. X-ray chest April 7, 1921, showed tuberculous right apex but no metastases.

Was treated by X-ray January 11, 1921. This was continued until a few days before operation.

Operation March 21, 1921. Complete disarticulation at hip by Wyeth method.

Microscopic examination showed spindle-cell sarcoma, arranged in nests, but large amount of necrotic material and some cells resembling giant cells. Shows extensive necrosis. There are a number of multinucleated cells of bizarre character. Highly malignant.

BONE TRANSPLANTATION USED FOR TIBIAL CYST

DR. JAMES K. YOUNG also presented a female, age eighteen, who at six years of age was kicked in the left ankle. About two months later the lower end of the tibia began to swell. She received no surgical treatment until about three years ago when she was operated upon and the lower end of the tibia was scraped. Following this operation, she was temporarily relieved, but several months later the cyst returned.

The patient came under his observation about two years ago and an X-ray examination revealed a benign cyst of the lower end of the tibia. She was operated upon at the Polyclinic Hospital May 19, 1920. At the operation the following condition was found. The cortex was thinned out, resembling an egg shell. The cystic content was a thick yellowish fluid. The wall of the cyst was lined with a thick capsule;

its shape globular, the bony walls of the tibia being equally distended in all directions.

The operation consisted in crushing the lower end of the tibia after a thorough curettage and implanting into the cyst cavity a bone graft from the opposite tibia. There was no post-operative hemorrhage and the patient has suffered no pain since operation.

On May 5, 1921, the tendo Achillis was divided for talipes equinus, since which time the foot has been perfect.

FOREIGN BODY IN THE ABDOMEN

DR. C. F. MITCHELL reported a case, number 4382-1921, who was admitted to the Pennsylvania Hospital on October 8, 1921, complaining of a painful swelling in the left groin.

Some three weeks previous to his admission, while running for shelter, he suddenly experienced a sharp and severe pain in the left lower abdomen. This pain persisted for several following days, but apparently it was not sufficiently severe to make him give up his work as a day laborer. A week later, however, he noticed that a small, hard lump was forming in the lower left abdominal quadrant close to the left groin. He complained that this lump was becoming increasingly painful at the time of his admission. He complained of no other symptoms and there was nothing in his history which pointed to involvement of either the gastro-intestinal or genito-urinary systems.

Examination disclosed in the left lower abdomen, just above Poupart's ligament, a small oval mass, roughly three cm. in diameter. There was no change in the texture of the overlying skin; the surface of the mass was very slightly irregular and firm in consistency, apparently adherent to the anterior abdominal wall and did not seem to be connected with the underlying structures. It proved to be only slightly tender to manual examination.

The provisional diagnosis of a tumor of the anterior abdominal wall was made.

Five days later an incision about seven cm. in length was made just above, and parallel to, Poupart's ligament. It was then found that the mass was not in the abdominal wall, but evidently intraperitoneal. The peritoneum was opened inferior to this mass, which was found to be adherent above to the peritoneum and laterally to the sigmoid. It was firmly bound up in a mass of omentum, and in all proved to be about the size of a small lemon. Little difficulty was experienced in freeing this mass and delivering it from the abdominal cavity. Apart from rather dense adhesions, there was no further involvement of the surrounding gut and no evidence of a perforation.

The mass which was apparently composed largely of omental tissue was incised. It proved to have a rather firm wall of irregular scar tissue, central to which there was a small cavity with a very uneven necrotic edge, the whole structure being very evidently the result of a chronic inflammatory process. In this central cavity a small piece of wood was embedded. It was about the size of a large toothpick, with one sharp-pointed end, and measured approximately three cm. in length.

The patient made a fairly uneventful recovery from the operation, although an infection of the abdominal incision took place which delayed healing.

On subsequent questioning of the patient he was unable to recall the ingestion of the small splinter of wood.

He was discharged from the hospital three weeks after operation in good condition.

MULTIPLE FIBROMATA OF THE ILEUM CAUSING RECURRENT DOUBLE INTUSSUSCEPTION

DR. WALTER ESTELL LEE reported the case of a female, forty years of age, admitted to the West Service of the Pennsylvania Hospital August 15, 1921, with the hospital number 3223. At the time of admission she complained of recurring attacks of pain in the lower abdomen which were accompanied by vomiting. These attacks were usually associated with tenderness in the right iliac fossa. She had come to the hospital June 25, 1921 (No. 2231) complaining of similar symptoms and at that time a provisional diagnosis was made of chronic appendicitis. The symptoms continuing, it was decided to remove her appendix at the second admission, and it was found to be practically normal by the pathologist.

She obtained no relief after the appendectomy and was admitted to the hospital for the third time September 3, 1921 (No. 3664), with symptoms of acute intestinal obstruction. The abdomen at this time was not distended, there was moderate tenderness and no rigidity and distinctly visible peristalsis and loud peristaltic sounds were heard on auscultation. No abnormal masses could be detected by abdominal or vaginal examination. There was a healed scar over the right lower rectus muscle, evidently made at the previous operation. The patient was operated on at 3 A.M. under ether anaesthesia. The abdomen was opened by excising the old scar. Distended ileum slightly darker in color than normal and containing considerable fluid immediately presented. The collapsed transverse colon was next found and followed to the ileocaecal valve and then the collapsed ileum was followed for about three feet when a large mass was encountered. Upon delivering this mass of intestines, which was about eight inches in length, it was found to be an intussusception of the ileum. The intussusception was readily reduced by milking the distal portion from the proximal mass. Two intussusceptions were found; in other words, the intussusception was a double one. Thus the intussusciens of the first intussusception was the inner layer of the second intussusceptum. By this arrangement the layers of gut from within out were (1) the entering tube; (2) the returning layer of bowel (1 and 2 constituting the first intussusceptum); (3) the first intussusciens, which was also the inner layer of the second intussusceptum; (4) the returning layer of the second intussusceptum; (5) the second intussusciens. Covering the inner layer of the first intussusceptum were white patches which were apparently fibrinous exudates. These were very carefully palpated and did not seem to involve any tissue except the peritoneum. The bowel was



FIG. 1.—Multiple fibromata of the ileum.

in good condition and the normal color of the involved ileum rapidly returned after the application of hot saline. The amount of ileum involved in this process was about twenty-four inches. The intestines were returned to the abdominal cavity and the abdomen closed by separate layers with iodized catgut. No drainage was used. The patient was discharged twenty-one days later after an uneventful convalescence.

September 27, 1921, three days after she was discharged from the hospital, the patient returned for the fourth admission with definite symptoms of intestinal obstruction (No. 4154). Under nitrous oxide anaesthesia the old scar was excised and the abdominal cavity opened. The abdomen was practically free of adhesions and distended bowel presented as at the time of the previous operation. Upon exploring the right iliac fossa a mass of ileum was found and delivered, which proved to be another intussusception, and involved exactly the same portion of bowel as at the previous operation. It was about the same length, eight inches, and was double as before. It was easily reduced by milking the distal portion from the proximal mass, when several small white areas were seen shining through the peritoneal surface of the involved bowel. Upon palpation masses were distinctly felt corresponding to these discolored areas which apparently were new tissue involving the entire wall of the bowel. About twenty-four inches of bowel was resected and the severed ends reunited by an end-to-end anastomosis. Iodized catgut only was used. The bowel was returned to the abdomen which was closed by layer sutures of iodized catgut in the abdominal wall. The patient was discharged at the end of twenty-one days after an uneventful recovery.

Upon opening the specimen of intestine by longitudinal incision in its centre is found an area 5.5×3.5 cm. just visible on the serous side from which two globular masses project into the lumen, 3 and 2.5 cm. in diameter, respectively. The mucous surface of the masses was deep red. They are firm and a translucent white on cut surface. Contiguous to them are two similar elevations rising out 4 cm. above the level of the normal mucosa. At other places in the intestine are masses of similar consistency over which the mucosa is normal in appearance and freely movable. They vary from 1.0 to 2.0 cm. in greatest diameter and one of them projects into the lumen as a finger-like process 3 cm. long and 1.5 cm. in diameter.

Microscopical Examination: The tumor is a moderately cellular fibroblastic tissue with some well-matured cells, but many which are imperfectly differentiated. Many of the nuclei have dark, irregular structures which could probably be interpreted as typical karyokinetic figures. The blood supply is small and consists of capillary whose walls are composed of a single layer of endothelial cells.

Diagnosis: Malignant fibro-blastoma.

Doctor Allen reported that he had had a similar case at the Bryn Mawr Hospital. The patient was a boy, about ten years of age, with intestinal obstruction caused by intussusception in the small bowel. The intussusception was reduced and the bowel opened. There were a number of masses, some-

what like those described by Doctor Lee, growing from the bowel wall. The larger ones were excised and the bowel closed. Several months later, the boy had another intussusception with obstruction. This time several inches of small intestine were resected. The specimen showed a larger number of polypoid masses, of varying sizes, than at the first operation. The patient recovered.

THYROID TOXÆMIA

DR. HUBLEY R. OWEN recited cases, illustrating the condition of thyroid toxæmia occurring in policemen and firemen under his care. They were shown for the purpose of demonstrating the prevalence of this condition among the members of the Police and Fire Departments. The speaker stating that he had under his care cases of thyroid toxæmia in the proportion of one to every 650 men, which seemed to him to be a high percentage. The constant excitement of their occupations may be a possible etiologic factor of the condition.

CASE I.—Hoseman "B," age forty-two. In 1920 had rheumatism. Also had pyorrhœa. Present condition began in March, 1921. First symptom was palpitation, followed by nervousness. In June, 1921, had badly diseased tonsils removed. Since his tonsillectomy has gained thirty-six pounds in weight and is much improved. Is being treated at the Jefferson Hospital by application of X-rays. Is now able to do active duty in the office of the Fire Marshal. The patient dated the onset of his symptoms to long and severe duty at a fire. Basal metabolism at present time, plus twenty.

CASE II.—Patrolman "S," age thirty-three. The first symptom was swelling of the thyroid gland. He noticed this in October, 1920. This was followed by marked palpitation, and then by tremors. He was admitted to the Police and Fire Ward, Philadelphia Hospital, and had tonsils removed. Since his tonsillectomy has gained ten pounds in weight, and is now doing active police duty. Basal metabolism at present time, plus two.

CASE III.—Patrolman "A," age thirty-nine. In Police Department for five years. In February, 1920, had diabetes. Loss of weight from 162 to 119 pounds. In June, 1920, first symptoms noted were nervousness and tremors, followed by enlargement of the thyroid gland. Has had no palpitation. His Wassermann was plus four. Was given specific treatment. Present weight 163 pounds. Has slight exophthalmus. No tremors at present time, and no palpitation. Is doing active duty in the Police Department.

CASE IV.—Patrolman "L," age forty-three. Served eleven years in Police Department. Had frequent attacks of tonsillitis and rheumatism. First symptoms of thyroid toxæmia started in 1919. First symptom noticed was nervousness, followed by palpitation, and enlargement right lobe of thyroid gland. He states that his nervousness began immediately following a fight which he had while making an arrest during a trolley strike. Had a complete thyroidectomy. At present time has marked exophthalmus. Palpitation and nervousness both im-

HYDROPS OF THE GALL-BLADDER

proved. He is doing active police duty. The highest basal metabolism was in this case, plus ninety.

CASE V.—Patrolman "W," age thirty-nine. Had influenza in 1919. Shortly after his attack of influenza noticed that he was losing weight. Had constant nausea, and this was followed by nervousness and palpitation, and lastly by exophthalmus. Has been treated by absolute rest, and monthly application of X-rays. Has gained eighteen pounds in weight. Still has some tremors and some palpitation. Is doing light duty. Present basal metabolism is plus twenty.

FOREIGN BODY IN RECTUM

DR. JAMES H. BALDWIN recorded a case reported to him by Dr. Horace Phillips, physician to the Eastern Penitentiary. The patient stated that he had introduced a piece of wood into the rectum to produce an evacuation of the bowels and that it had slipped from his grasp and he was unable to remove it. Digital examination showed a foreign body as high in the rectum as could be reached by the tip of the examining finger. Under ether anæsthesia the sphincter was dilated and a piece of wood, eight and three-fourths inches long, was grasped by forceps and easily withdrawn. The patient suffered no ill effects. He was about thirty-five years of age, never had any visitors, was of cleanly habits, and never gave any trouble. This is probably a case of sexual perversion, known as pederasty.

HYDROPS OF GALL-BLADDER

A second case record reported by Doctor Baldwin was of a female, age sixty, admitted to the Methodist Hospital, on the medical service of Dr. Paul Reiff, November, 1920. Her only complaint was a vague and continual discomfort in the upper abdomen and a sense of dragging and pulling in the right upper abdomen, especially on standing. A very careful study of her case was made by Doctor Reiff and a diagnosis made of gall-bladder disease with stones probably present. A number of negative X-rays were taken for gastro-intestinal and gall-bladder study. The patient was transferred to the surgical service and operated upon by the speaker December 14, 1920. On exposing the gall-bladder region the gall-bladder could neither be seen nor felt. In exploring downward to bring up the appendix a firm, irregular mass was encountered resembling a malignant growth of the ascending colon, which proved, however, to be a gall-bladder nine inches in length, five inches in circumference and tensely distended with fluid, a case of hydrops with large stones. There was a sort of meso-gall-bladder about four inches wide, and when the gall-bladder was brought out of the incision it stood five inches above the surrounding skin. A cholecystectomy was very easily done and the patient made a quick and uneventful recovery and has remained well since. It was interesting to find out why these large stones did not show in the X-ray pictures. Was the composition of the stones at fault or was the failure due to the fluid in the gall-bladder? It is claimed that stones will not show if there is much fluid, as there was in this case. The radiographic research showed that

it was not the composition of the stones. Therefore it is believed the failure of the stones to show while in the patient was due to the fluid tensely distending the gall-bladder.

HERNIA OF FEMALE REPRODUCTIVE ORGANS INTO THE INGUINAL CANAL

DR. HENRY P. BROWN prefaced the report of an instance of the above complication by remarking that hernias of the ovary or ovary and tube, or ovary, tube and uterus in the inguinal canal, present a rather unusual and interesting variation from the usual variety of inguinal hernia. Not infrequently one finds an ovary situated in this region, its presence here being due to a congenital defect in development.

Cranwell,¹ quoting Herwig, states that when the Wolffian bodies commence to atrophy during the third month of fetal life, the ovaries descend from the lumbar region into the false pelvis, being in contact with the psoas muscle. It is probable that the inguinal ligament of the Wolffian body acts on them, as Hunter's gubernaculum, the gubernaculum testis, does on the testicle. The later position in the descent of the ovaries differs from that in the descent of the testicles in that instead of being arrested in the inguinal region, the ovaries descend normally into the true pelvis.

In certain exceptional cases the ovaries are able to comport themselves as the testicles, coming to lie in the inguinal region opposite the canal of Nuck. Sometimes they stop here, but they are also able to engage themselves within the abdominal wall, traversing the inguinal canal. The ovary is thus able, in imitating the testicle in its descent, to enter the inguinal canal and also engage the uterus, especially if the latter is bicornuate due to an abnormality of development.

In most cases only the ovary is engaged, but several instances have been reported in which a Fallopian tube and the uterus have accompanied it.

Doctor Jopson² reported such a case and gave a very good review of the literature up to that time. Royster³ has recently reported another, reviewing the literature up to last year.

Most of the recorded instances occurred in women who had been pregnant one or more times, and most writers agree that this is an important factor in producing the condition. Some of the cases, however, were in women who had never borne children.

A severe sudden abdominal strain is an important predisposing factor and was mentioned as having occurred in several of the cases.

In the case reported the uterus, both tubes, and ovaries were contained in the sac.

An apparently healthy, normally developed colored child of five months was first seen in the dispensary of the Children's Hospital on Doctor Jopson's service on June 4, 1921, to whom the speaker is indebted for the privilege of operating upon it. She presented swelling in the region of the left labia about the size of a small almond, which her mother said had been present since birth. The mother stated that the

birth had been normal and the swelling had not varied in size, was unaffected by the child crying and had never disappeared.

Examination showed a rather firm, somewhat movable, but irreducible mass in the region of the external ring, not tender on pressure, constant in size and not transmitting any impulse when the child cried. The child was apparently otherwise normal in every respect. A tentative diagnosis of hernia of the left ovary was made.

Early in the morning on the day set for operation, the child had a severe crying spell, and on examination the nurse noticed that the mass in the inguinal region had become very much larger. It was thought that a knuckle of bowel had become forced into the sac.

At operation, under ether anæsthesia, the usual Bassini incision was made, opening the inguinal canal and exposing a well-developed sac which extended into the labia. The sac was opened and found to contain the uterus, both tubes and both ovaries, apparently normally developed for a child of that age.

The hernia was of the indirect type and its contents were easily reduced after relieving a moderate constriction at the internal ring. An area on the inner wall of the sac was very suggestive as being part of the urinary bladder and the sac was therefore not completely removed. The canal was closed after the Ferguson method and the child made an uneventful recovery.

Undoubtedly the strain incident to the crying spell was the factor which caused the uterus and its appendages to be forced into the hernia sac, this being in accord with the strain mentioned in most of the cases.

It was not absolutely certain that part of the bladder was present in the sac, especially as the hernia was of the indirect type, but from the appearance of that part of the sac, the slight difference in color, increased thickness and the sensation on palpation, it was at least very suggestive.

DOCTOR JOPSON, in discussing the subject of hernia of the uterus, stated that in 1904 he had made an exhaustive study of this subject and compiled from the literature what he believed at that time to be a complete list of the cases in which the uterus had been observed to be present in the sac of an inguinal or femoral hernia. The ventral forms, which are the most frequent and which result from separation of the rectus muscle during pregnancy, were not considered. The earliest case of hernia of the uterus was observed by Nicholas Pol in 1531. There had been twenty-one instances reported up to 1904, his case being the twenty-second. Of these nine occurred in association with pregnancy. Pregnancy may occur in the uterus before or after it becomes herniated. There were also two undoubted cases of femoral hernia of the non-pregnant uterus. In many of the cases some malformation or lack of development of the genital organs was present. Eight cases of hernia of the non-pregnant uterus had been operated upon previously. In the more youthful cases the contents of the sac could usually be reduced. Since this report was made several articles on the subject had appeared, including more or less comprehensive ones by Cranwell, of Buenos Aires,

in 1908, and Sutton in 1909. Cranwell collected forty-five cases and Sutton fifty cases. The speaker had either overlooked, or was unable to obtain at that time, Oge's paper published as a thesis in Paris in 1900. Both it and Cranwell's and Sutton's papers are quoted in the most recent article which has appeared on the subject, namely that of H. A. Royster (1920). Royster, and Sutton and Upton, whom he quotes, dwell on the frequency of congenital malformations in associations with this hernia. In very few cases is the diagnosis possible before operation. It might be suspected if a hernia was found in association with atresia of the vagina or other perceptible external malformations or lack of development, and in young female children especially. Hernias of unusual type should be studied with the view to the detection of this malformation or of what is more common, hernia of the ovary alone.

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INTRAPERITONEAL RUPTURE OF THE BLADDER

DR. T. TURNER THOMAS read a paper with the above title.

TUBERCULOSIS OF ELBOW CURED BY X-RAY

DR. G. M. DORRANCE showed a man, age forty, with a history of tuberculosis of the left knee and hip-joint that had been cured in childhood.

Patient was under the speaker's care for one year previous to the administration of X-ray treatment. When first seen he had tuberculosis of the right elbow-joint with numerous sinuses leading down to diseased bone. The X-ray plates showed marked destruction of the lower end of the humerus and entire involvement of the joint. On account of scar tissue from former operations, an excision of the joint was impossible. Removal of bone and curetting of the sinuses was performed several times. Bier's hyperæmia was used. X-ray treatments were given first at three-day intervals and later at seven-day intervals. The sinuses rapidly closed and have not reopened. It is shown as an adjunct to the usual surgical procedures used in tuberculosis of joints.

AVULSION OF PALM

A second case, presented by Doctor Dorrance, was of avulsion of the skin and subcutaneous tissue of the palm treated by abdominal pedicle graft occurring in a man, age twenty, admitted with a history of crush of the hand and loss of the skin and subcutaneous tissue of the palm.

Examination showed the skin and flexor tendons exposed and arteries pulsating. The skin and subcutaneous tissues were lost from one inch below the flexor crease at the wrist-joint to one inch above the metacarpal phalangeal crease and extending almost out to the lateral margins of the

SKIN TENSION BUTTONS

palm. The wound was treated for four days with dichloramin-T and then an abdominal flap of skin was reflected up and sutured to the edge of the palm. On the tenth day, the flap was partially divided from its abdominal connection. Each day thereafter more was divided until the pedicle was completely divided. This skin has gradually contracted from the sides towards the centre so that now the graft is about two-thirds as large as it was when the sutures were removed. Twelve weeks have elapsed since the operation and sensation is gradually returning in the graft.

SKIN TENSION BUTTONS

DOCTOR DORRANCE presented the above apparatus with the following description: The value of these buttons is that they have two points of contact with an intervening concave surface that gives some support but allows sufficient blood to enter to prevent necrosis. The ends and sides are slightly everted to limit as much as possible the so-called digging in of the buttons.

The slot at the end allows the mattress suture to be applied without the necessity of attempting to pass the needle and suture through an eye at either end. When the sutures are all inserted and ready to tie, the buttons are put in place. They may be used as an ordinary mattress or an end mattress.

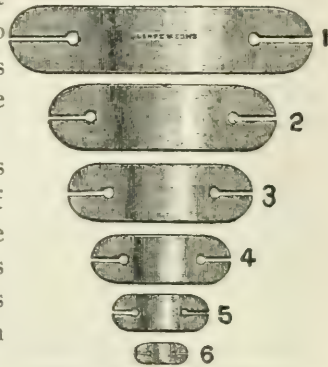


FIG. 2.—Skin tension buttons.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

Stated Meeting Held January 25, 1922

DR. EUGENE H. POOL in the Chair

THE RELATIVE MERITS OF GASTROSTOMY AND JEJUNOSTOMY IN CANCER OF THE CARDIAC END OF THE STOMACH

DR. NATHAN W. GREEN presented two cases to bring out discussion as to the relative merits of gastrostomy and jejunostomy in cancer of the cardiac end of the stomach. In this class of cases the patient may sometimes be too ill to undergo an operation for gastrostomy or the stomach may be too contracted to allow of the formation of a suitable stoma. In this event the jejunostomy is better. It takes less time and in these very enfeebled cases it performs the function of a stoma with the minimum of surgical trauma. It has this disadvantage, it will easily become so closed should the feeding tube be withdrawn too long that it will be very difficult to reinsert the tube. This also may be said of the Kader-Senn type of gastrostomy, where the stoma tract is lined with connective tissue following the disappearance of the single layer of endothelial cells of the peritoneum. The advantage of the gastrostomy of the Janeway type is that it makes a permanent tube lined with the mucosa of the stomach which leads from the stomach to the skin. This type of gastrostomy is most suitable in cancer of the cardia, as it does not close spontaneously and has the advantage that should the patient leave out his tube for a considerable time it can be reinserted without difficulty.

CASE I.—A male, fifty-seven years of age, was X-rayed August 31, 1921, and the diagnosis made at that time of obstruction of the œsophagus with a filling defect involving the cardiac end of the stomach about the orifice of the œsophagus. He stated that in June, 1921, he felt a sense of fullness at the cardiac end of the stomach after meals, which was followed by dull pains radiating to the left side. He had a series of X-ray treatments, five in number, by Doctor Herendeen, of the Memorial Hospital, and was admitted to the City Hospital, where a Janeway gastrostomy was done by Doctor Green, October 23, 1921. No metastasis was found in the liver at that time. The patient has had no X-ray treatment since November.

CASE II.—A male, forty-eight years of age, was first seen at the Memorial Hospital on November 4, 1921. He was in fairly good condition. An indefinite mass was felt in the mid-epigastrium which was slightly tender. For the past six years he had had frequent attacks of cramp-like pain in the abdomen with occasional bloody vomiting, loss of weight, and weakness. A röntgenogram taken November 12, 1921,

showed a filling defect on the lesser curvature of the stomach. He also gave an indefinite history of dysphagia. On November 21, 1921, he was admitted to one of the wards of the Memorial Hospital and was operated upon on November 23rd. There was a mass in the cardiac end of the stomach, the size of an egg, and the lymph-glands were found involved. A jejunostomy was done, using the Witzel method. He was discharged December 14, 1921, and was referred to Doctor Herendeen for a cycle of X-ray treatments, which will be given very shortly.

JEJUNOSTOMY IN ULCER OF THE LESSER CURVATURE AND POSTERIOR WALL OF THE STOMACH

DR. WILLIAM A. DOWNES presented a boy eighteen years of age, to demonstrate the value of jejunostomy in this class of cases. On March 3, 1921, he was admitted to the medical service of St. Luke's Hospital suffering from a three weeks' attack of epigastric pain and vomiting. There was low red blood-cell count and blood was found in the faeces. X-ray examination revealed a marked deformity of the stomach, gastrospasm being indicated at the pyloric end and at the lesser curvature, the appearance of the latter suggesting the possibility of perforating ulcer. A provisional diagnosis was made of bleeding ulcer of the stomach located on the lesser curvature and posterior wall. The patient was acutely ill, with lips and mucous membrane ashen gray. He was very much undernourished and was put on an ulcer diet (Bastedo) and given two blood transfusions. Only slight improvement followed and, his general condition growing worse instead of better, operation was decided upon, and March 25th, under gas and oxygen anæsthesia, an exploratory gastrostomy and jejunostomy was done, a five-inch incision being made in the upper right rectus. There were dense perigastric adhesions between the lesser curvature of the stomach, the parietal peritoneum, and the liver. A large indurated mass was felt which involved the lesser curvature and posterior wall of the stomach and was apparently adherent to the pancreas. The ulcer crater was exposed by a three-inch incision in the middle of the anterior wall of the stomach. The ulcerated area was about three inches in diameter and extended well up on the posterior wall and lesser curvature. Excision was impossible on account of the size and location of the ulcer, so the opening in the stomach was closed by a continuous suture of chromic catgut. Because of the fact that absolute rest of the stomach was necessary in order to control the bleeding which was an important indication, as well as on account of the extent and location of the ulcer, it was decided to perform a jejunostomy, thereby placing the stomach at absolute rest. Feedings through the tube in the jejunum were begun in twenty-four hours, four ounces of milk being given every two hours, gradually increased to eight ounces, with addition of eggs, meat juice, and cereal. Small quantities of water were allowed by mouth. Continuous Murphy drip of five per cent. glucose. Three post-operative transfusions were given at intervals of two weeks. Three months after operation the red blood-cell count had increased and the stools were negative for blood. On July 1st he was discharged

from hospital, having gained ten pounds in weight, and his general condition being much improved. He returns to the hospital weekly and appears to be in excellent health. The tube has been removed from time to time to be cleansed; there has been no irritation of the skin and no leakage from the stoma. He has gained thirty-six pounds in weight and has returned to his work as a chauffeur. The large gastric ulcer has apparently healed and the stomach functions well when filled with a full opaque meal. To be certain of the permanent healing of the ulcer the jejunostomy will be kept open for at least one year from the date of operation.

DR. WALTON MARTIN thought that these cases illustrated several points well worth considering. In the first place, it is not simply a question of the advantages and disadvantages of jejunostomy and gastrostomy. Doctor Green's cases illustrate a particular method of making a gastrostomy. He used the Janeway procedure which is admirable if a permanent opening is sought, lined with mucosa, with little or no tendency to close, but the method has the disadvantage of requiring half an hour or more to perform—a serious matter in weak and half-starved patients. The question as to when to do a simple gastrostomy and when to do a jejunostomy should be determined largely by whether or no one wishes to give absolute rest to the stomach, or whether nutrition alone is to be considered. It is surprising to see how little the skin is irritated in the jejunostomies. Doctor Downes' case is an example of very sound judgment in selecting the proper operative procedure. The improvement in this patient has been astonishing.

DR. JOSEPH WIENER said it was of no consequence, if one used local anæsthesia, how long it took to do an operation. He had not recently done a gastrostomy or jejunostomy under ether and it was entirely unnecessary. He had done a number of gastro-enterostomies under local anæsthesia lately with happy results, and with these debilitated patients that should be kept in mind.

DR. JAMES I. RUSSELL had no experience with the Janeway gastrostomy, having never done it, but he has used the Kader-Senn method a number of times, under local anæsthesia, during the past few years. Most of these patients have had carcinoma of the lower end of the œsophagus and the cardiac end of the stomach. It would seem that they improve for a little while and then gradually grow weaker and die. He was glad to know that Doctor Green's patient was able to walk about. As for Doctor Downes' case, he had a similar one recently, a young man eighteen years of age, who had had profuse hemorrhages and was in very bad condition at the time of entering the hospital, suffering excruciating pain. He was transfused three times, after which he improved sufficiently to have a posterior gastro-enterostomy done under gas oxygen. He stood the operation well, the pain became much less, the bleeding stopped, and at the end of a month he was discharged from the hospital. He had greatly improved, was quite free from pain, and no blood could be found in the stools. The ulcer was a large indurated one

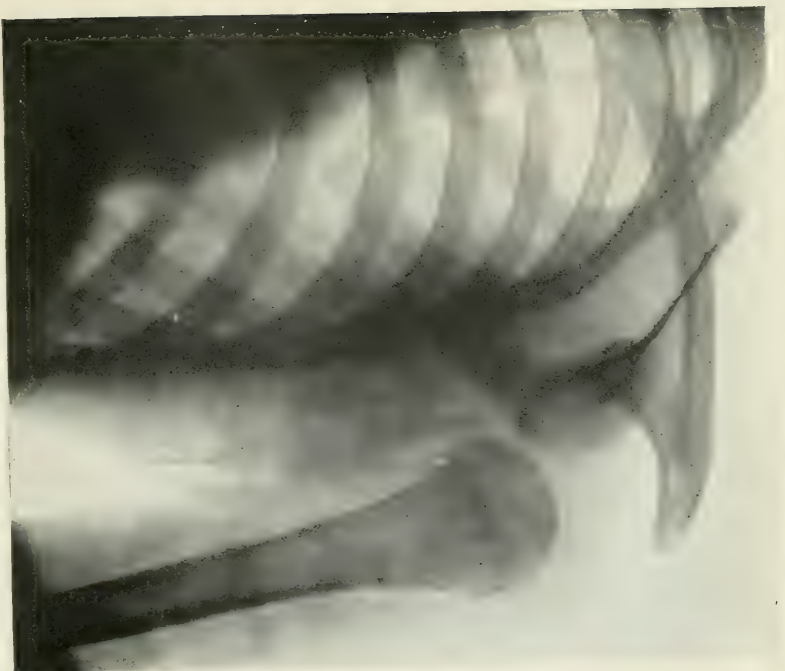


FIG. 1.—Radiograph showing persistent subglenoid dislocation of shoulder.

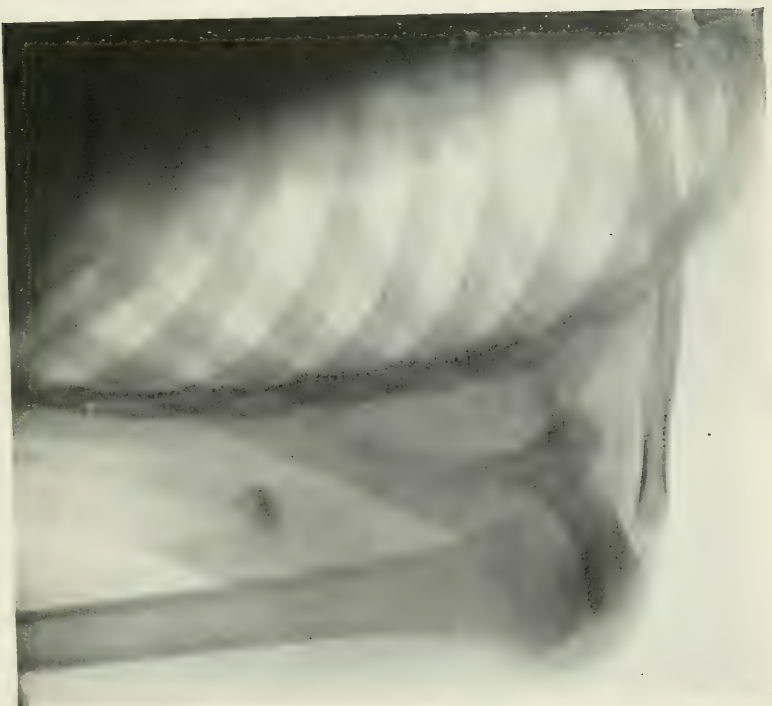


FIG. 2.—Radiograph showing condition of shoulder after capsulorrhaphy.

CAPSULORRHAPHY FOR SUBGLENOID DISLOCATION OF SHOULDER

located on the posterior surface of the first portion of the duodenum and it could not be excised.

DR. EDWARD W. PETERSON thought that the point Doctor Green wished to make was that the Janeway type of gastrostomy was preferable where a permanent opening was desired. In carcinoma of the œsophagus or cardia the Janeway operation is ideal because the patient has a mucous-lined tube leading from skin to œsophagus, which will not close spontaneously if the rubber tube is withdrawn. A word of caution should be spoken, however; occasionally a stomach was so contracted from disuse that it could not lend itself to the proper performance of a Janeway gastrostomy.

DOCTOR DOWNES, in closing the discussion, said that he believed jejunostomy was preferable to gastrostomy for two reasons: First, it gives the stomach complete rest, thereby lessening the tendency to bleed, and also relieves pain; and secondly, it does not leak. If there is no blood in the stools and if the stomach functions properly, at the end of one year the tube will be removed and the patient left alone. The wisest thing to do is to treat a patient as a cured case when the stools no longer contain blood.

CAPSULORRHAPHY FOR PERSISTENT SUBGLENOID DISLOCATION OF SHOULDER

DR. DEWITT STETTEN presented a little girl eleven years of age. As a younger child she had several dislocations of her left shoulder induced by rather trifling trauma. The dislocation was always easily reduced and the head of the humerus remained in place after reduction. About the middle of July, 1921, while at camp, she injured her left shoulder. A dislocation is supposed to have occurred which was reduced but apparently the head of the humerus did not remain in position.

When first seen in September she had a subglenoid dislocation of the left shoulder. The head of the humerus could be felt in the axilla and there was a marked depression between it and the tip of the acromion. There was not very much pain, but motion, especially adduction, was decidedly limited. This dislocation was very easily reduced even by the patient, who could pull the head of the bone into the socket by a contraction of her deltoid. As soon, however, as she allowed her muscles to relax the dislocation recurred. There were no indications of any paralyses.

X-ray examination shows a not quite complete subglenoid dislocation of the head of the humerus. There is no evidence of bony injury.

After an unsuccessful attempt to cure the deformity by bloodless reduction and fixation, operation was decided upon. The operation was performed on October 14, 1921. The usual anterior curved incision over the shoulder was made. After separating the fibres of the deltoid, a very much relaxed and somewhat thinned capsule was exposed. Without opening the joint, the capsule was reefed by two layers of interrupted chromic catgut sutures. The suture line extended from the axillary portion of the capsule to a point as far posteriorly as could be reached. Redislocation was attempted after the capsulorrhaphy, but was unsuc-

cessful. The wound was closed and a modified Velpeau bandage applied.

X-ray examination, after operation, showed the head of the humerus in good position in relation to the glenoid cavity, slightly higher than normal.

The wound healed by primary union. The arm was kept immobilized for a period of six weeks and then gradual active motion encouraged. The mobility of the joint slowly returned to normal and there has been no tendency toward dislocation since the operation. The skin scar shows some keloid formation, which is, however, diminishing.

DR. ALFRED S. TAYLOR inquired if there was any history of paralysis, in the first case, of the muscles around the shoulder. Also if examination had been made to determine if there was loss of power to account for the persistent dislocation. It did not seem possible that this could repeatedly occur if the muscles were all right. It was significant that, after suture of the capsule, the arm was immobilized for a time in a position relaxing the weakened shoulder cap muscles. This period of time was about the same as that required by nerves partially paralyzed by overstretching (an event not uncommon in just this type of fall) to recover their function.

DR. ROYAL WHITMAN thought that the disability caused by the displacement would account for the atrophy as there appeared to be no evidence of paralysis.

DOCTOR STETTEN replied to Doctor Taylor that no electrical examination for paralysis had been made in the case as it did not seem necessary. The muscles were roughly tested by active motion and appeared to functionate satisfactorily. The history of repeated traumatic dislocations and the absence of any history of polynyelitis tended to eliminate a muscular paralysis as an etiological factor. The deltoid, though somewhat atrophied now from disuse, was never paralyzed. In fact, before the operation if the patient voluntarily contracted her deltoid it actually pulled the head of the bone into place and when she relaxed it the head of the bone fell out of the socket so that one could put the finger between the head of the bone and the tip of the acromion. Immediately after the stretched capsule was reefed, attempt at dislocation during the operation was unsuccessful. This would also tend to prove that the actual stretching of the capsule and not a muscular paralysis was the causative lesion of the disturbance.

LONGITUDINAL SECTION OF PATELLA FOR JOINT MOUSE IMPACTED IN INTERCONDYLOID NOTCH

DOCTOR STETTEN presented a man twenty-four years of age, who for some time had had trouble with his left knee, which would occasionally lock but usually unlocked without any difficulty. Five days before Doctor Stetten first saw him the knee suddenly locked in a moderately flexed position. Since that time the patient has been unable to unlock the knee.

Examination showed a knee flexed at an angle of about 135 degrees. The joint could be further flexed but could not be further extended, either actively or passively. It was not possible to unlock the knee by manipulation. There was a slight effusion in the joint. Somewhat above and to the outer side of the patella one occasionally felt a small loose body which slipped from under the fingers.

X-ray examination shows a small, elliptical shadow above and to the outer side of the patella and another larger, more irregular one in the intercondyloid notch. These shadows are fairly opaque and are unquestionably joint mice.

Operation was performed on May 30, 1921. The Jones' operation was decided upon as the most satisfactory method of approach. This incision would give access to the intercondyloid notch without damage to the extensor apparatus of the knee-joint and would be the most feasible in the face of the taut quadriceps and patella tendons. Accordingly, using a tourniquet, a longitudinal incision was made over the patella with the knee hanging over the edge of the table in its flexed position. The patella was exposed and the quadriceps and patellar tendons were divided longitudinally. The patella was divided longitudinally with a saw and the joint opened. The halves of the patella were dislocated laterally over the respective inner and outer condyles. The smaller joint mouse was easily found in the outer pocket of the quadriceps bursa and removed. Another, somewhat larger joint mouse, was found lodged in the intercondyloid notch, imbedded in the outer aspect of the inner condyle and wedged between the inner condyle and the corresponding joint surface of the inner tibial tuberosity. This was easily removed with a forceps and no further mice were found in the joint. The synovial membrane was then closed, the incisions in the quadriceps and patellar tendons were carefully sutured, as was likewise the periosteum over the patella. The bone was not sutured. The skin was closed and a posterior splint applied to the easily extended joint.

The wound healed by primary union, and after six weeks massage and gradual passive motion were ordered. The joint rapidly regained its mobility and in three months after operation function was normal, with solid bony union of the patellar halves.

DR. HERMANN FISCHER said that he recently had made use of the Jones operation for opening the knee-joint for the removal of a joint mouse. The X-ray picture showed a loose cartilaginous body in the upper recess of the joint. Although the joint mouse was of a large size, it could not be felt. Opening of the upper recess of the knee-joint by a longitudinal incision failed to disclose the body. In order to explore the joint thoroughly, the incision was prolonged downward over the middle of the patella by sawing and the two halves were pulled apart by retractors. The access into the joint was excellent, but again he failed to locate the loose body. It was finally found tucked away in the upper recess of the joint, encapsulated in a reduplication of the very much thickened and chronically inflamed synovial membrane. The

closure of the joint was very simple. It was not necessary to put sutures through the patella; the two halves came in close contact by a chromic catgut suture of its thickened periosteal covering. The advantage of this method of entering the knee lies in the fact that the extensor apparatus is not at all interfered with. In this case the knee was only immobilized for ten days, then careful passive motion, and four days later active motion was begun. Three weeks after the operation the normal range of motion without pain was restored.

DR. WILLIAM A. DOWNES asked Doctor Stetten if he did not think six weeks was too long a time to immobilize the joint in this case, on account of the danger of the formation of adhesions and the unnecessary delay in convalescence.

DR. ROYAL WHITMAN thought that immediate movement of a joint after operation with the aim of thereby preventing adhesions and limitation of motion was a mistake. Sufficient time should be allowed to permit primary union before resuming function.

DR. JOSEPH WIENER agreed with Doctor Downes rather than with Doctor Whitman. In the old days there were disagreeable results following immobilization of fracture of the patella, for there is difficulty in getting motion after six weeks of immobilization. Early motion in these cases may be wrong, but therapeutically it is entirely right.

DR. EUGENE H. POOL considered that most physicians allowed motion for fracture very much earlier than formerly, and in fracture of the patella particularly they were beginning to allow active motion in bed within several days of operation, and the results have not been disadvantageous, but have been beneficial. If that could be done with a transverse fracture, it would seem that one could do as much safely with longitudinal section of the patella. He asked Doctor Stetten if any disadvantages or complications had been reported following this method.

DOCTOR STETTEN, in closing the discussion, regretted that he had been misunderstood as having said that he immobilized the knee for six weeks. He had left the splint on for only three weeks and after that allowed the patient to move the knee in bed. He did say, however, that after six weeks massage and gradual passive motion were ordered. He had been somewhat conservative, as this was his first experience with the operation and he had not wished to take any chances. He felt that it was not easy for the two patellar halves to separate after suture of the dense quadriceps and patellar tendons. He thought the best answer to the statement that conservative treatment might impair the eventual mobility of the joint was the perfect function of the knee in this case. This returned very quickly after the patient began walking around. Doctor Stetten said that his first experience with this method had led him to believe that this was the very best means of approaching the centre of the knee-joint, giving the greatest possible exposure without in any way damaging the extensor apparatus.

ANOMALOUS ABDOMINAL MEMBRANES. THEIR INFLUENCE UPON THE DIGESTIVE TRACT

DR. ALFRED S. TAYLOR read a paper with the above title, for which see page 513, May ANNALS OF SURGERY, vol. lxxv.

DR. WILLIAM A. DOWNES mentioned two or three cases which he had observed at the Babies' Hospital in which the first portion of the duodenum had a short mesentery, which bore out Doctor Taylor's contention as to this condition being congenital. He showed on the blackboard a diagram of a case of non-rotation of the intestine which he considered corroborated Doctor Taylor better than anything he could mention. This baby was sent to the hospital for pyloric obstruction. At operation a definite band was found running across the duodenum just before it joined the jejunum; this band was divided, the obstruction was freed, and the baby made a perfect recovery. The band measured two and one-half inches in width. The speaker asked Doctor Taylor if he considered the patient cured who was also relieved of symptoms after the appendix was taken out three years before.

DR. EUGENE H. POOL thought that when much importance is placed upon the three types of bands or membranes, mentioned by Doctor Taylor, if a case fails to improve the surgeon is inclined to feel that not enough adhesions or bands had been severed. In subsequent cases he is therefore led to do more radical work. He believed that there was a tendency here to lead to a lot of dangerous operating. In Doctor Taylor's hands a number of cures would doubtless result from operations that would bring serious disaster to others.

DR. NATHAN W. GREEN considered that Doctor Taylor's paper showed a very great deal of thought and logical reasoning. The trouble with many surgeons was that when they undertook an operation for the cure of symptoms of indefinite origin they found several conditions in the pathology, any one of which alone might be accountable for these symptoms. They felt in order to render a cure, all of the findings must be corrected. They were unable to say that this band or that appendix or this gall-bladder alone was the offending cause. Therefore they removed all these and the result might be surgically good but scientifically somewhat inaccurate. Few have the moral courage to leave the gall-bladder and appendix, even if they appear normal, and merely divide the band.

DR. WALTON MARTIN was reminded of the remarks of Doctor Moschowitz made some time ago in a discussion on the subject of operations for veils and adhesions and replacement of displaced organs. Doctor Moschowitz said he felt confused. There were surgeons who were enthusiastic supporters of fixing the stomach and colon or reefing the cæcum and there were other surgeons equally enthusiastic in freeing the colon and dividing adhesions for a group of patients presenting similar symptoms and presenting a similar anatomical picture. As to the adhesions and peritoneal folds about the cæcum, he thought it most difficult to say what was normal and

what abnormal. Many years ago he had examined the ileocæcal region systematically on the cadaver for Professor Huntington and tabulated the results. Professor Huntington was interested in the cæcal fossæ and the folds. In several hundred examinations there were very few that presented the three normal folds, an upper vascular, an intermediate non-vascular and a lower vascular, with the adhesion of the intermediate non-vascular with the lower vascular. The arrangement which was normal at birth had become modified by secondary adhesions and bands in nearly every instance.

For his part Doctor Martin said he found it often very difficult to say that a given adhesion was an abnormal adhesion, both regarding those in the region of the first portion of the duodenum and in the ileocæcal region. He did not refer to well-marked obstruction from a definite band but to veils, broad non-vascular bands and adhesions. It is often a matter of nice judgment for each surgeon to decide for himself whether a given band or adhesion is giving clinical symptoms, and possibly the decision depends somewhat on the enthusiasm, optimism and preconceived notions of the surgeon himself.

DR. J. P. HOGUET referred to the question of these bands having been brought up by Morris in 1902, who gave to them the name of "gall-spider cases"; and by Harris, in 1914, who reported some with the bands across the duodenum. In Doctor Hoguet's opinion they were all purely developmental from the embryological anterior mesogastrium. Many such cases are seen in the dissecting room even in very young subjects and presumably never gave symptoms. He had operated on a number, however, in whom the symptoms were very marked and who were relieved by operation.

DR. W. W. HERRICK expressed the medical point of view in these matters as being one of inquiry and not as yet of unreserved acceptance. In his own work in the study of chronic digestive disturbances, with the aid of fluoroscopy, he had not been impressed with the frequency of these cases, although the work of Doctor Taylor was highly suggestive of new fields of diagnosis. One or two physiological questions had occurred to him while listening to the reading of Doctor Taylor's paper. Are not conditions in the digestive tract in a normal state different from those presenting themselves under an anæsthetic when the abdominal cavity is opened? Care in exerting unusual torsion on normal membranes and ligaments would seem advisable, and the differentiation of normal and abnormal bands most difficult. Careful X-ray study would certainly throw light on such phases of the question. This is a very suggestive and valuable work and is of great importance to the internist.

DOCTOR TAYLOR, in closing the discussion, took up first the question regarding the cure of these cases. He did not consider any patient permanently cured until he was dead without having suffered a recurrence of symptoms. The point was that he did not report any case less than two years after operation and some had been operated upon seven years ago, and the cases were reported as to cures, etc., up to date. The thing that had been most interesting

to him was that from some of the group that had not been heard from in two years and that he had put down as "improved," he got reports, after this paper went to the printer, stating that they were better after five years than they had been after two years. The second case presented this evening has been well for three years, and eight weeks after the day she was operated upon she was back doing her work. Of all the cases, eighty-six per cent. are very much better than they were before operation, thirty-two per cent. of the fifty cases being complete cures to date. With regard to the suggestion that it is dangerous to get surgeons interested in doing this operation, the mortality rate refutes this. There was only one death in the fifty cases and this patient died of post-operative pneumonia; so as to danger, this operation ranks very low. With regard to Doctor Martin's discussion, it is true that these conditions have been treated in a great variety of different ways with good results. There was one surgeon who sutured the cæcum and entire colon in the position he thought normal and reported a good result. The thing that had impressed the speaker was this: given a digestive tube, it does not make so much difference what its position in the abdomen may be, so long as it is not sharply kinked or compressed. These membranes cause kinking and so obstruct the flow of the contents, and if one can make the tube mobile by plastic procedure, the symptoms will be overcome. He had confined his attention to section and plastic suture of the membranes, trying thus to mobilize the gut. He believed with Doctor Martin that it was difficult to pick the normal. Too little attention has been paid to the membrane above the cæcum proper; the membranes distal to the cæcum usually cause dilation of the cæcum and secondary distention of the appendix, and frequently cause dilation and incompetency of the ileocæcal valve. Whether or not these conditions are abnormalities is a question for discussion. These conditions as seen on the operation table impressed him as abnormal. When the gut is freed one can see it fill so promptly as to indicate that there must have been real obstruction. Doctor Hoguet's remarks on his observations in the dissecting room are very interesting and corroborate the evidence presented in the paper. Doctor Taylor regretted that he had not had time this evening to go into all the side issues of the subject, but they are dealt with in the paper and those interested can follow them up. The conditions are real and it is of interest to know if operation has something to offer. If after a man has had experience with a number of cases, he can take the history, make a physical examination, study the X-ray plates, predicate in seventy-five per cent. of cases what is the condition, and then go into the abdomen and be able to verify the predictions, it would seem that there was a real pathological entity which merits careful study. When one releases these bands, which are apparently at fault, and the patients are relieved of their symptoms and keep improving in general health as time goes on, one would think there was a definite relation of cause and effect between these two series of events.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

Stated Meeting Held February 8, 1922

The President, DR. WILLIAM A. DOWNES, in the Chair

COMPLETE CAST OF THE STOMACH DUE TO BURN

DR. ALEXIS V. MOSCHCOWITZ presented a young man who, with suicidal intent several weeks ago, swallowed a quantity of muriatic acid. Very excellent first-aid was given promptly and his life was preserved, but two weeks afterward on account of persistent vomiting he was referred to Mt. Sinai Hospital. A day or so before he came to the hospital he vomited a large amount of material which was saved, and on examination was shown to be a complete cast of the mucosa of the stomach. Towards the duodenal end the lumen was still retained. The patient suddenly stopped vomiting and for a long time was able to take considerable nourishment; however, while he is taking nourishment now, he is losing considerably in weight. During the early part of his stay in the hospital a jejunostomy was considered, but he took nourishment so well that this idea was abandoned for the time being. When it was considered safe, he was X-rayed. The œsophagus was found to be patent throughout; the stomach was much contracted, and there was some narrowing of the pylorus. A few days ago the patient was able to pass upon himself a full-sized stomach tube. He now vomits very frequently and there seems to be a constriction of the pylorus, although some food passes through. A more recent X-ray showed upon the much contracted stomach a peculiar nipple-like shadow which was not visible in the first X-ray, which may or may not be a penetrating ulcer. The chemical examination of the stomach contents failed to reveal the presence of hydrochloric acid or ferments.

This patient was presented on account of the rarity of such injury, and to secure advice regarding future action.

Later Note.—(Since the presentation of the patient, he vomited a great deal, and continued to lose weight so rapidly that the conclusion was inevitable, that there existed an almost complete stenosis of the pylorus. He therefore was operated upon on the first of March. The entire stomach was found contracted so as to resemble a section of small intestine. The walls were densely infiltrated. The anterior surface of the stomach for a space of about two square inches, right at the cardia, was free from infiltration; a gastro-enterostomy done at this point. The only operation feasible was that of anterior retrocolic gastro-enterostomy, which was done with the aid of a Murphy button. The patient stood the operation perfectly well and thus far is doing well in every respect. He has not vomited once during the past ten days and retains all nourishment permitted.)

NON-ROTATION OF LARGE INTESTINE

DR. GEORGE WOOLSEY spoke of a patient who came to him two years ago after swallowing hydrochloric acid; he had uncontrollable vomiting, lost weight, and the X-ray showed marked narrowing of the pyloric end of the stomach beginning sharply two and one-half inches from the pylorus. A gastro-enterostomy was done and three months later he was in perfect health and had gained thirty-four pounds in weight.

DR. EDWIN BEER said that he had seen a complete exfoliation of the interior of the bladder following the use of mercurochrome, and much to his surprise there was no contraction of the organ as proven by subsequent operation. He had never seen a case of exfoliation of the mucous membrane of the stomach which, apparently according to the case presented, was behaving quite differently from the case in which a similar process took place in the bladder.

NON-ROTATION OF LARGE INTESTINE

DR. CARL EGGERS presented a woman, thirty years of age, who had been having attacks of cramp-like abdominal pain for the last ten years. The first attack confined her to bed for two weeks. Subsequent attacks were not quite as severe and of shorter duration. They were not accompanied by fever or vomiting. The present attack started a few days before admission to the Lenox Hill Hospital. At the onset the pain was general over the abdomen, but it had become more localized on the right side. There had been no fever or vomiting. She was a rather anæmic but well-nourished young woman. The abdomen was distended. There was no rigidity. No organs were palpable. There was tenderness on pressure over McBurney's point, and also on the left side.

Vaginal examination was negative except for tenderness in the right adnexal region.

Operation (August 14, 1920).—A three-inch Kammerer incision was made on the right side. Some clear free fluid found. Loops of small intestines presented. There was no omentum visible and search revealed an empty right lumbar gutter, no colon or cæcum seen. Incision extended upward for thorough exploration. To visualize the condition it was necessary to bring the small intestines out of the abdomen, and it was then found that the transverse colon was folded on itself from right to left, and that the cæcum and ascending colon were situated in the left side, resting on the descending colon, with the ileum entering the cæcum from the right side. An enormous appendix, a hydrops, larger than a thumb, was found and removed in the usual way. In order to relieve the attacks of pain it was decided to place the intestines into the position considered normal. Before doing this, further examination was made and the following points were noted:

The cæcum and the ascending colon had a very long mesentery. The duodenojejunal junction was situated on the right side of the mesentery. The liver was on the right side. In order to replace the gut, the small intestines had to be completely drawn around, as they were evidently

rotated. They were held directly upward by an assistant by means of a hot towel and the transverse and ascending colon with the cæcum were then placed into their normal position. This was easily accomplished on account of their long mesentery. After replacing these the small intestines were put on to the now anterior leaf of the mesentery. No attempt was made to fasten the cæcum or ascending colon into place, first, because it was assumed that the small gut resting on their mesentery would hold them there, and secondly, because no obstacle should be placed in their way in case they wanted to resume the position they had occupied during the last thirty years.

The convalescence was uneventful. There was no unusual gas disturbance.

The subsequent course has been marked by occasional cramp-like pains, never as severe as before operation. An X-ray study made September 14, 1921, by means of a bismuth meal and also a bismuth enema, shows that the cæcum and colon have remained in the position in which they were placed. There is some redundancy of the colon. During the application of the enema there was no suggestion of any obstruction and no complaint on the part of the patient about discomfort.

DR. ELLSWORTH ELIOT, JR., said he had had a case of acute appendicitis complicated by an anatomical condition of this kind which was interesting for two reasons. While the patient was twenty-four years of age, she had previously never had the slightest abdominal disturbance. Secondly, while prior to operation the symptoms of peritoneal irritation were most marked in the right lower quadrant, the ileocæcal junction with the appendix was found just above and to the left of the umbilicus. This discrepancy between the site of the appendix and the area of maximum rigidity was accounted for by the fact that the seropurulent exudate had accumulated in the lower right portion of the peritoneal cavity. This patient was discharged after convalescence and there was no record of the permanent result. No attempt was made to restore the ileocæcal junction to its usual position.

DR. WILLIAM A. DOWNES spoke of a case of non-rotation in an infant referred to him as a case of pyloric stenosis. At operation a band two inches wide, running across the lower duodenum, was divided, the intestine was freed and the baby made an uneventful recovery.

ACUTE PYELONEPHRITIS COMPLICATING APPENDICITIS

DOCTOR EGGERS presented a girl of nineteen, who was admitted to the Lenox Hill Hospital July 30, 1921, for an interval appendix operation. She had just passed through an acute attack of appendicitis at home. On admission all acute symptoms had subsided, and temperature, pulse and blood-count were normal. Tenderness over the appendix was still quite marked. On account of increased frequency in urination operation was delayed until the urinary tract could be excluded. Urine found normal. No kidney tenderness.

Operation (August 1, 1921).—Appendectomy in usual way. No drain required. For three days after operation the patient was unable

to void and had to be catheterized. Except for that the post-operative course was normal until the seventh day, when she had two chills lasting about twenty minutes each. The temperature rose to 103. Coincident with this she developed severe pain in the left lumbar region, radiating downward along the ureter, accompanied by frequency and burning urination. There was rigidity of the left lumbar muscles. The urine was clear, but contained albumen and clumped pus-cells. High temperature, pain and urinary symptoms continued. X-ray for stone was negative. The cystoscope showed the bladder capacity normal. Both ureter openings normal, clear urine obtained from both sides in approximately equal amount. Phenolphthalein excretion appeared in fourteen minutes on the left side, seventeen minutes on the right side. Sterile urine specimens from both kidneys and the bladder. All three showed colon bacilli. A diagnosis of bilateral colon infection of kidneys was made, more severe on the left than on the right side.

There was no improvement in the symptoms, pain was severe, blood examination showed white blood-cells, 16,000; polymorphonuclears, eighty-five per cent. There was marked tenderness over the left kidney.

*Operation—Decapsulation of Left Kidney (August 22, 1921).—*In order to properly expose the kidney, it was necessary to resect the twelfth rib. The kidney was enlarged and more adherent than normal. There was no free pus. The surface of the kidney was studded with many small abscesses. A decapsulation was done. Two of the small abscesses were cultured and showed colon bacilli. A cigarette drain was placed at the lower pole of the kidney and the wound then closed.

Immediately after operation all pain ceased. Patient was able to void normally. Except for a chill and a short febrile period, September 4th to 7th, there was no disturbance of convalescence. Patient was discharged in good condition and has since remained well.

DR. CHARLES H. PECK believed this case to be an example of a common condition, an acute hæmatogenous infection of the kidney rather than a true pyelonephritis. This is a complication of many infective conditions. Many of these cases will subside without operation, and he believed Doctor Eggers had shown good judgment in decapsulating instead of removing this kidney. Some years ago when the speaker had seen kidneys presenting the appearance much as Doctor Eggers described them with multiple dots, he took these kidneys out and the patients made good recovery, but he knew later on that he could have saved the kidney just as well. Many go through a sharp inflammatory reaction and if left alone they will subside spontaneously without any surgical interference at all. Another group become perinephritic abscesses. He had operated on one in which a cortical kidney abscess was at the point of rupture. He had watched a number of these cases with acute tenderness and high fever, often running to 105°, and a large percentage had subsided spontaneously. They show the urinary findings that Doctor Eggers reported, a few pus and a few blood-cells only. It is not an inflammation of the urinary tract but of the cortical parenchyma of the kidney.

DR. NATHAN W. GREEN referred to a case under his care about twelve years ago at the City Hospital, a young girl of seventeen, who had right-sided pain over the kidney. He decapsulated the kidney and found it spotted with red hemorrhagic spots one-half cm. in diameter and some of these spots had a yellow centre. He thought decapsulation was enough and drained down to the site of the kidney. She ran the usual history of temperature and made a smooth convalescence from the right-sided trouble. Then without much of an interval she started up a left-sided pain with a picture similar to the preceding. The left-sided condition was left entirely alone and it subsided without operative interference in about the same time as the right side.

DR. EDWIN BEER said that there is a very definite distinction between colon and coccic infections of the kidneys. The former are usually associated with pyuria and, unless obstruction of the outflow of urine is present, rarely require operation and, then, usually only decapsulation. On the other hand, the coccic infections rarely show more than a few red blood-cells in the urine and are liable to produce perinephric abscesses as they perforate into the perinephric tissue. The more violent cases require early operation before perinephric perforation takes place and at times even nephrectomy may be required to save the patient's life; in some cases nephrotomy and opening of the abscess, and in others, resection of the septic area have led to satisfactory results. In those cases where the two types of infection are associated, the diagnosis is particularly difficult and, despite the presence of colon bacilli and pus in the urine, if the patient's condition does not improve rapidly on flushing, it may be necessary to arrive at the conclusion that one is dealing with a mixed infection and, therefore, be compelled to operate.

DR. WILLY MEYER cited a case that he treated many years ago. The patient was a lady who had acute renal colic with chills and subsequent high fever. There was no time to catheterize the ureters; just a chance to take an X-ray before operation. Nephrotomy was done and the upper portion of the ureter drained through the renal pelvis after a probe introduced from above had located the stone. A great many small abscesses were seen in the renal cortex; one or two were punctured and the pus cultured, and the colon bacillus was found. The fever quickly subsided. After some time the stone was removed from the ureter and the patient made a perfect recovery. These cases should certainly be treated as much as possible conservatively; here drainage without decapsulation sufficed to save the organ.

LATE RESULTS OF MIDGASTRIC (SLEEVE) RESECTION FOR HOUR-GLASS CONTRACTURE OF STOMACH. (TWO CASES.)

DR. WILLIAM A. DOWNES presented these cases. The first was a woman, forty-one years of age, who came to the hospital complaining of pain in the stomach after eating. This had been of seven years' duration, was sharp and cramping and came on about two hours after meals, being

LATE RESULTS OF MIDGASTRIC (SLEEVE) RESECTION

worse at a point just above the navel, though sometimes spreading throughout the abdomen, especially in the right lower quadrant, and was relieved by taking food. She belched much gas and often vomited sour acid material, in which there was no blood. There was no blood in the stools nor were they ever black or tarry. She lost thirty-five pounds in the seven years. Examination showed the abdomen to be soft; no spasm or rigidity. There was definite tenderness in right upper quadrant at the lower angle near the umbilicus. Pulsation of abdominal aorta could be easily palpated. Operation was decided upon and on November 6, 1916, the abdomen was opened. On delivering the stomach into the abdominal wound the cicatrix of a gastric ulcer was seen in the anterior gastric wall near the middle of the lesser curvature; attached to this cicatrix was a small prolongation of the omentum. The site of the ulcer was quite indurated and the stomach wall around it, especially toward the cardiac end of the stomach, was rather œdematous and swollen. Long slender clamps were placed across the stomach, one above and one below the site of the ulcer; on the ulcer side of each clamp were placed two stout heavy clamps, each including about half the stomach wall to be resected; the stomach wall was divided just distal to the heavy clamps and the whole of the section of the stomach, including the gastric ulcer, was removed. The two ends of the divided stomach were then brought close together and sutured; the gastrohepatic omentum, which had been divided, was sutured to the remaining lesser curvature of the stomach; the divided gastrocolic omentum was sutured to the remaining greater curvature of the stomach. Interrupted sutures of fine silk reinforced all the sutures. The patient made an uninterrupted recovery and was discharged from the hospital fifteen days after operation. She is now well, has no pain or tenderness, has no nausea, vomiting or eructations. She eats five small meals a day and keeps the bowels open.

The second patient was also a woman aged forty-one years, who was admitted to the hospital December 30, 1917, complaining of gnawing pain under the ribs on the right side, which had lasted for fourteen days. It began after a light meal, and she also had heartburn. She vomited frothy fluid, and the stools were black. She had suffered similar attacks since childhood and had lost eighteen pounds in two years. The pain had no relation to meals, was aggravated by acid fruits and relieved by soda. Examination showed the abdomen to be slightly distended and there was slight tenderness and rigidity in epigastrium. The day following her admission to the hospital she was operated upon and the abdomen opened through a long right rectus incision. On the lesser curvature of the stomach, about two inches from the pyloric ring, there was a large puckered ulcer extending from the anterior surface of the stomach well to the posterior surface; the posterior part was adherent to the anterior surface of the pancreas. There were a great many adhesions in the omentum and in removing the ulcer a small portion of it remained adherent to the pancreas. There was no sign of perforation. Two long stomach clamps were placed, one proximally and one distally

to the ulcer site, through openings made in the gastrohepatic omentum and in the gastro-colic omentum small bayonet clamps were placed within the area of the stomach between the clamps and going to within about one inch of the pyloric ring and including the ulcer. It was then removed and the stomach walls were sutured, the first layer approximating the part in the posterior serosa and the posterior mucosa, and another layer was taken by means of Connel sutures closing the wall, including both the mucosa and serosa; then a reinforcing suture was taken entirely around the site with a continuous suture of 000 chromic including the serosa, then a few reinforcing sutures taken through the serosa of silk. The opening made in the peritoneal layers was closed, the stomach reduced into the abdomen, and the wound closed in the usual manner. The patient presented a good appearance and the stomach symptoms from which she had suffered were greatly improved.

DR. GEORGE WOOLSEY said he had had a number of cases of sleeve resection, about nine in all. Three of them could not be followed, but his records showed that the other six did not have ultimate results as good as he had brought about with other forms of resection. They were, however, among the worst cases he had had of gastric ulcer. In five of them there were adhesions posteriorly, in three the pancreas formed the base of the ulcer, one had tuberculosis, three were heavy drinkers, and two had lues. There were good results in sixty-six per cent., that is, two-thirds of the cases. One of those that was classed as a poor result was a patient with lues who went along for two years and four months with very satisfactory results following operation. He then took to excessive drinking and relapsed. Another poor result was a poor risk from the first. Mesogastric resection has a place in surgery. In certain cases where about three inches of the pyloric end of the stomach is normal, with or without any hourglass contraction, it is an excellent operation. It is especially good in cases where the ulcer is posterior and adherent where excision is not easy or advisable.

DR. RICHARD LEWISOHN considered that the results of midgastric resection shown by Doctor Downes were certainly very good. The sleeve resection has been abandoned by most surgeons in favor of partial gastrectomy as the vast majority of these cases are not cured by a midgastric resection. The speaker had reexamined lately four cases of sleeve resection performed by Dr. A. A. Berg, at Mount Sinai Hospital, four years ago. Three of these patients showed a residue after six hours. Sleeve resection is apt to cause hourglass formation of the stomach. Partial gastrectomy is quite as simple an operation and should be considered the method of choice in the majority of cases of penetrating ulcers of the lesser curvature of the stomach.

DR. NATHAN W. GREEN thought that this series, though very interesting, was more or less confusing to the physiologist because it is known that the innervation of the stomach is by the vagus nerves. The interference with the motor innervation of the stomach does not seem to be a very important thing as recounted in Doctor Downes' series.

LARGE URETERAL STONE IN INFANT

DOCTOR DOWNES, in closing the discussion, replied to Doctor Lewisohn that the sleeve resection had not been done so often in recent years because these advanced cases with deformity were not so frequently seen as formerly. For ulcer, with hourglass deformity, situated near the middle of the stomach, it is wickered to remove two-thirds of the stomach when one can get a perfectly satisfactory result with this operation. The results shown this evening will substantiate that statement. If cases are properly selected, this should be considered a standard operation.

LARGE URETERAL STONE IN INFANT

DR. FREDERIC W. BANCROFT presented a child, who was admitted to the New York Hospital first on December 18, 1918. At that time it was two years of age. The complaint was then a right-sided hernia and frequency of urination. An X-ray was taken December 20, 1918, which showed no stone in the bladder. Urinalysis showed many pus-cells which were clumped.

The child was again admitted on December 17, 1919, with a history of frequent urination. At this time another X-ray was taken of both kidneys and the bladder, which was negative for calculus. Urine still contained pus.

The child was readmitted on November 22, 1921, and at this time X-ray showed that there was a large stone situated just beneath the crest of the symphysis. On December 5, 1921, he examined the child under a fluoroscope. The stone did not move when the child assumed a vertical or horizontal position. With a finger in the rectum and pressing down from above it was impossible to quite reach the lower border of the stone.

December 6th the child was anesthetized and a small No. 9 cystoscope passed. There was a marked cystitis of the bladder and the bladder was found to be remarkably large. The light from the cystoscope transilluminated almost as high as the umbilicus. It was impossible with this small cystoscope to catheterize the ureters. No stone could be seen in the bladder.

Doctor Busby's report of the X-ray taken on December 2, 1921, was as follows: "Calculus in the pelvis posterior portion rather internal for right ureter and rather high for bladder. Possibly it is a stone in a bladder diverticulum or a fæcolith."

Physical examination of the child was negative, there being no tenderness or mass in the region of either kidney. The ante-operative diagnosis was difficult to make. We assumed that there was no stone free in the bladder and that, as it was so large with no history of renal pain, it seemed most probable that it was a stone forming in a diverticulum of the bladder.

Operation (December 8, 1921).—Right paramedian incision. Peritoneum opened high. Bladder was found much enlarged, extending almost to the umbilicus and particularly toward the right side. The stone was felt outside of the bladder and apparently in the ureter.

It was freely movable from the lower part of the pelvis to about two cm. up above the sacral prominence. The peritoneum was then closed. The peritoneum was retracted along the lateral wall, exposing the ureter and posterior portion of the bladder retroperitoneally. It was difficult to bring the stone up. It was finally grasped but could not be satisfactorily exposed, so that the bladder was opened. With finger in the bladder, it was easy to bring up the ureter. Longitudinal incision was made in the ureter and a stone about four by one and five-tenths cm. removed. Finger was inserted in the ureter; it was enlarged about two cm. in diameter from just above the bladder to about three cm. above the crest of the sacrum. Beyond this a vertebrated probe could be easily passed to the kidney pelvis. Distally, vertebrated probe descended to the region of the trigone but not into the bladder. The kidney was palpated. It showed a rather marked hydronephrosis. The kidney, however, was not enlarged. The wound in the ureter was closed with a double Lembert suture, and the incision in the bladder was closed in a similar manner. Through a stab wound near the anterior superior spine, a dressed tube was inserted. Abdominal wound then closed in layers without drainage.

Post-operative Course.—There was no leakage of urine and median incision healed by primary union. Stab wound was closed within ten days. Child is now up and about and apparently in good condition.

The question naturally arises whether this stone could have been present two years ago when the X-rays were negative or whether such a large stone could form in such a short time. Analysis of the stone shows it to be a calcium phosphate stone. There is slightly more calcium on the peripheral portion than in the central portion of the stone. This, of course, might mean that in the earlier period, the stone being small in diameter and of less calcium content, it might not have shown in the X-ray, while as its diameter increased in size and the calcium content increased, the shadow became very evident as shown in the X-ray.

TRAUMATIC SUB-DURAL PNEUMATOCELE WITH AIR IN THE VENTRICLES

DR. NATHAN W. GREEN reported the case of a man, age forty-five years, who was admitted to the City Hospital, service of Doctor Green, on Saturday, October 29, 1921, with a history of intoxication and having been struck on the forehead. He was unconscious and had a laceration of the forehead. His blood-pressure was 116/170, pulse 84, respiration 24, temperature 97, on admission; and his spinal tap showed a normal flow which was somewhat blood-tinged. The diagnosis on admission was laceration of forehead and fracture of the skull. He was given urotropin gr. vii as soon as admitted and this was continued until December 1, 1921. On Sunday, which was the following day, he regained consciousness and the X-ray was allowed to wait, as there were no focal symptoms of brain injury. He was kept in bed five days and during that time had continuous headache. When he got up and tried to walk he felt dizzy and began to sweat profusely. He also vomited. No fluid



FIG. 1.—Picture 20 days after injury showing air in left ventricle with a smaller amount in right ventricle.

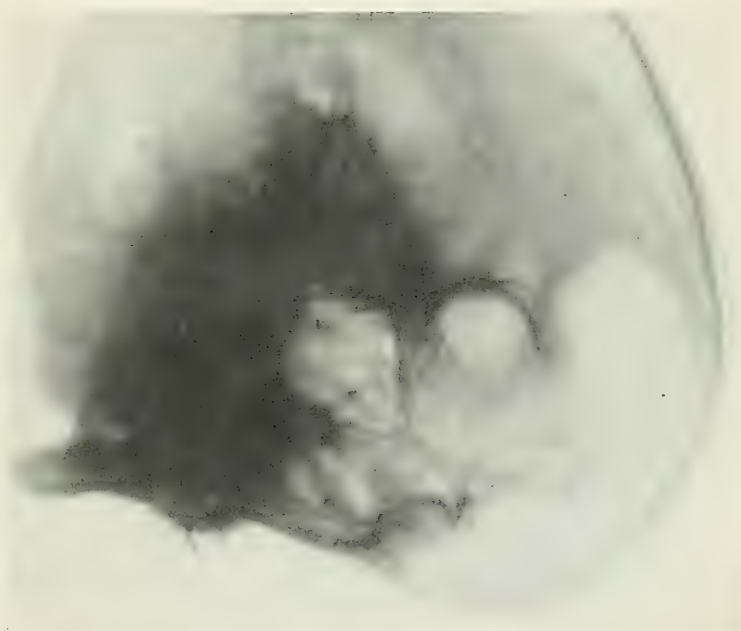


FIG. 2. Diagonal view of head. (The plate has been reversed in printing.)



FIG. 4.—Lateral view showing sub-dural air, and ventricle outlined by air.

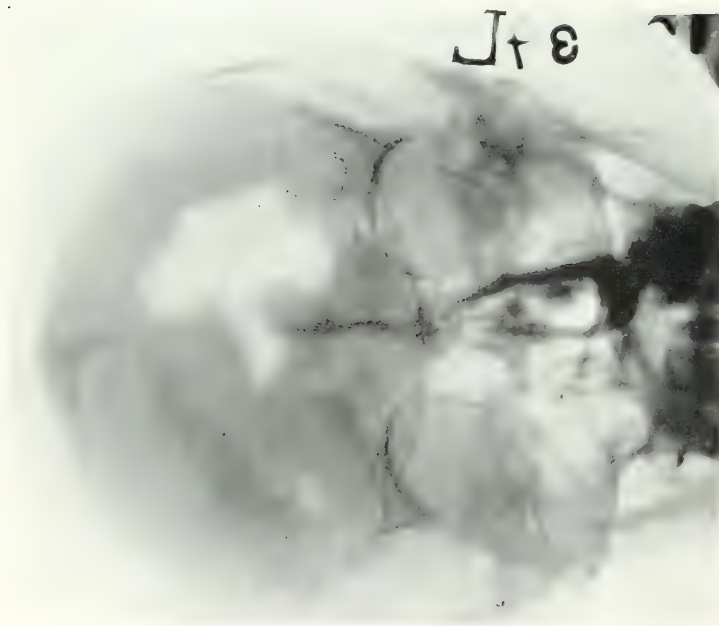


FIG. 3.—Picture twenty-four days after injury. Showing air in left ventricle with a smaller accumulation in right ventricle. Amount of air seems to be greater than in Fig. 1.



FIG. 5.—Shows accumulation of air. Trephine defect. Fracture. (Four days after operation.)

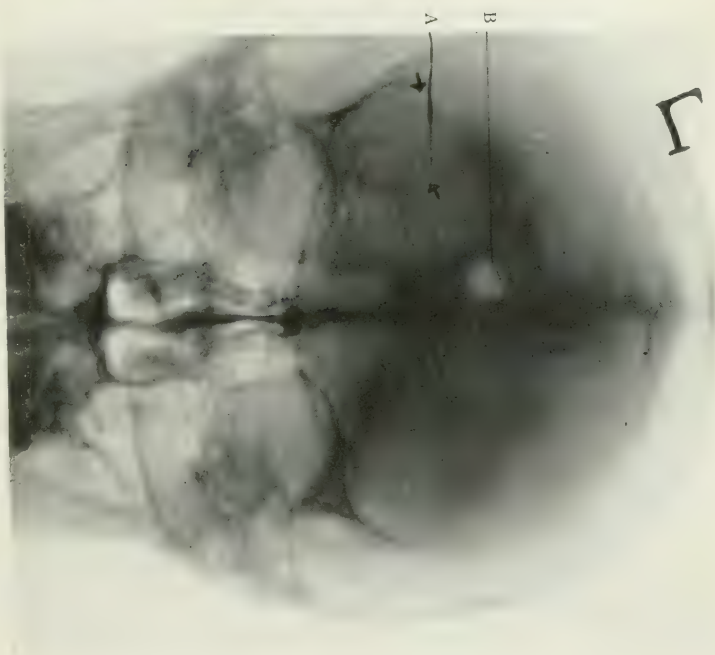


FIG. 6. Shows fracture of frontal bone. A. Trephine opening. B. It shows also that the air has been absorbed. Picture taken January 9, 1927, nearly two and one-half months after injury; and six weeks after operation. (The plate has been reversed in printing.)

ran out of his nose as yet. The symptoms led to an X-ray and a shadow, which was so conspicuous that it was thought to be an artifact, was found (Fig. 1). To exclude the possibility of an artifact another picture was taken to show the diagonal diameter of the head (Fig. 2). Then another picture duplicating the first one showed the same shadow.

A note by Dr. J. H. Larkin, on November 3, 1921, reported the colloidal gold test for spinal fluid negative.

Another note by Doctor Larkin, on November 7, 1921, showed the blood for Wassermann negative.

A note by Doctor Pardee, on November 11, 1921, gave a diagnosis of cerebral concussion.

A note on November 18th, by Dr. A. P. Evans, the röntgenologist to whom he was indebted for this picture, reported the left ventricle as showing an air accumulation with a small accumulation in the right one; and on the surface of the anterior left frontal lobe a large air accumulation. A linear fracture of the left frontal eminence was described. This condition is well shown by Figs. 3 and 4. A note by Dr. N. W. Green, on November 21st, said that the patient was mentally about the same as since regaining consciousness, but that his general appearance was worse. The possibility of a low-grade infection with gas production was considered.

On November 25, 1921, after talking the case over with Dr. Alfred S. Taylor, an operation was performed under novocaine by Doctor Green. The frontal bone was opened with a small trephine over the point of air accumulation, as shown by the X-ray, and an exploratory needle inserted through the dura. Air was withdrawn which was odorless. The needle was then inserted further (about ten cm.) and cerebrospinal fluid withdrawn. The needle was then partly withdrawn again and saline solution introduced (about two ounces in amount). When about half-way through this procedure the patient began to cough and said water was running down his throat. This was the saline which had been introduced into the dura—demonstrating a direct connection between the dural cavity and the accessory sinuses. The hope was to fill this cavity with saline while letting out the air with another needle. But after repeated trials this was given up. The wound was then closed by suture. Time of operation fifty-five minutes. Pulse before the operation was sixty. After the operation ninety-five. Fluid kept running out of his nose for some time—about four weeks after the operation.

A note by Doctor Strouse on November 28, 1921, reported the eye grounds as negative.

On December 9, 1921, the wound of operation was entirely healed and the patient was complaining of nothing.

A note by Dr. Howard D. Collins, on December 15, 1921, on whose service the patient then was, described the patient as complaining of dizziness, but Doctor Hunt advised no further interference.

Doctor Navas noted that on December 23, 1921, succussion was present in the head. This was also noted by Doctor Schwartz on December

25th, and a further note said that the patient seemed unduly cheerful (a possible frontal involvement). The patient got up after the first of the New Year and was allowed full freedom of the ward. About January 29, 1922, he contracted a coryza, but went through it without mishap. He is now as well as formerly and he has no headaches.

DOCTOR GREEN's interpretation of the case is that there was a fracture of the cribriform plate and through that the air entered the dura. One of the X-rays showed a slight faulting here. The fracture of the frontal bone is quite obvious. He was indebted to the men mentioned in this report for their extreme courtesy and helpfulness in working up this case.

DR. CHARLES A. ELSBERG recalled seeing a case of this kind a year ago. The patient had air in the cranial cavity and in the ventricle, about as much as in the films Doctor Green showed. There were no symptoms after injury except some local swelling. The claim has been made that air may get into the ventricles through the floor of the third ventricle.

OUTCOME OF THE STAPHYLOCOCCUS INFECTIONS OF THE FACE AND LIPS

DR. WALTON MARTIN read a paper with the above title.

DR. WILLY MEYER considered that although there was some truth in the statement that some of these cases can be treated too early by operation, personally, he believed with Doctor Martin that if these cases were seen early an important step in saving the patient was gained. With an advanced sinus or deep jugular phlebitis naturally little could be done. In all the cases he had treated since 1895 he at once employed Bier's hyperæmic treatment, placing an elastic band around the neck. Again and again he could demonstrate the great value of this procedure in the early treatment of boils and carbuncles of the face and neck. The elastic band is applied around the neck immediately above the clavicles, but not too tightly; it must be comfortable for the patient to breathe, swallow, speak, etc. First it is kept on continuously for twenty-four hours, then it is removed for one hour of each twelve hours. If the œdema is not too pronounced the band can be left in place for forty-eight hours. As soon as the pus pustule forms at the top of the infiltration surgery steps in while typical hyperæmic treatment is continued. Many more of these patients die than recover if they are operated upon too early.

DR. CHARLES H. PECK agreed thoroughly with the principle of "hands off" treatment in most of these cases in the early stage. He had seen within the month an example of this sort of furuncle of the right nostril which for a week had been subjected to several incisions. He saw the patient in the afternoon; in the morning he had had complete loss of sight in the right eye and the temperature had been 103°. At five P.M. the temperature was 105.8° and he was quite delirious, with congestion of the upper part of the face and forehead, and he died in twenty-four hours of the onset of these symptoms from septic thrombosis of the sinuses. The original furuncle was not very extensive. This was the only fatal case Doctor Peck had seen;

OUTCOME OF STAPHYLOCOCCUS INFECTIONS

he had not seen any of the severe types Doctor Martin spoke of, but he believed non-surgical treatment in the early stages was what he should select.

DR. JOHN DOUGLAS said there are many cases of furuncle of the nostril but they do not seem to be quite the same virulent type as those furuncles of the skin of the lip. Perhaps they are not so easily traumatized. Whether the seriousness of these lesions is due to a difference in virulence or in the resistance, it is difficult to say, but trauma certainly affects their course adversely. It is a curious coincidence, that two cases they had at St. Luke's occurred in two sisters, the infections occurring one year apart; both ran the same sort of a severe course and one died as a result of her infection. One patient, a man seen outside the hospital, had a small furuncle of the lip which he had picked with a scarf pin. He died of hæmiplegia. At autopsy they found rupture of one of the cerebral vessels with an area of meningitis and a softened area in the brain. The cellulitis had spread over the side of the face, but no pus had developed in this area at any time and the infection, as usually occurs in these cases, had spread along the vessels rather than by the lymphatics.

DR. FORDYCE B. ST. JOHN related the case of a young woman of twenty-two years of age, who was admitted to the Presbyterian Hospital within the last five weeks, having been treated for a carbuncle, which completely involved the upper as well as the lower lip. She had a temperature of 104° , pulse of 120, and blood test positive to staphylococcus hæmolyticus on two examinations, separated by an interval of five days. She had been treated by a local physician for two weeks. She was taken to the operating room and multiple incisions made. The pathological picture found was that which Doctor Martin described. For over a period of fifteen years she had been subject to boils, presumably staphylococcus aureus infections. There was apprehension as to the prognosis, but eventually the lesion cleared up and the patient got well. The speaker cited this case because of the extent of the lesion and the possibility of a cumulative resistance to staphylococcus aureus acquired over a long period of time.

DR. DEWITT STETTEN spoke of several of these fatal cases that he had seen at the Lenox Hill Hospital, a few of which were reported by Doctor Bullock some years ago. Although he did not recall the autopsy records in these cases he was under the impression that they showed a multiple pathology. He did not believe that death in these cases is always due to the same pathological condition. In some cases a cavernous sinus thrombosis from direct venous extension may be found, in others a bacteriæmia may be the cause of death. A third cause is a meningitis of purely lymphatic origin. He saw such a case last year. The patient was a moribund child who had had an insignificant furuncle of the ala nasi which had not been operated on and which had practically healed. The child had a staphylococcic meningitis demonstrated by lumbar puncture. The speaker was in agreement as to the conservative treatment of these furuncles, and advised strongly against

the use of local anæsthesia, as infiltration into the infected area in this locality is a particularly dangerous procedure.

DR. ALLEN O. WHIPPLE inquired if Doctor Martin had found associated with these cases a condition resembling erysipelas. The patient Doctor St. John referred to had a condition of the skin which, aside from the carbuncle, resembled erysipelas and which subsided under cold applications to the parts. This was the third case he had seen with this associated condition.

DR. WILLIAM A. DOWNES remembered seeing two of the cases on Doctor Martin's list, one a private patient who came to him four or five days after an incision in the nose and in forty-eight hours had marked bulging of both eyes and died of sinus thrombosis. That patient had been for a long time in the habit of plucking the hairs from his nose. The other patient went to the dispensary of St. Luke's and had a small furuncle on his upper lip opened. When he was brought into the wards a few days later, both eyes were bulging, and he died twenty-four hours afterward. As to the treatment, the thing to do is to leave these patients alone, except to apply hot water until the lesion points.

DOCTOR MARTIN, in closing the discussion, replied first to Doctor Whipple that none of the patients on his list had presented any features resembling erysipelas. In regard to the warning by Doctor Stetten as to the use of local anæsthesia, the speaker agreed with him. As to the treatment by hyperæmia mentioned by Doctor Meyer, Doctor Martin said he had referred to a paper published on that subject and had given Lexer's criticism; personally he had had no experience with it. In closing, he wished to express his thanks to the members of the Attending Staff at St. Luke's for their kindness in permitting him to use their case reports.

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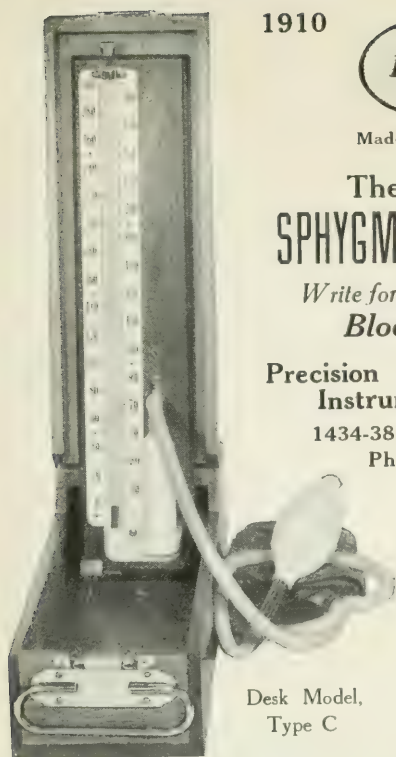
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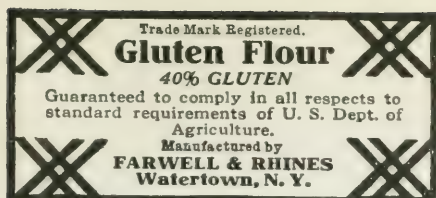
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